“A CLINICAL STUDY OF POST OPERATIVE COMPLICATIONS OF EMERGENCY AND ELECTIVE (OPEN & LAPAROSCOPIC) APPENDICECTOMY”

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CERTIFICATE

This is to certify that the dissertation entitled "A CLINICAL STUDY OF POST OPERATIVE COMPLICATIONS OF EMERGENCY AND ELECTIVE (OPEN & LAPAROSCOPIC) APPENDICECTOMY" is the original work done by Dr.N.EASWAR, Postgraduate in Department of General Surgery, Tirunelveli, to be submitted to The Tamilnadu Dr.M.G.R. Medical University, Chennai-32 towards the partial fulfillment of the requirement for the award of M.S.Degree in General Surgery April 2014.

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ABSTRACT

BACKGROUND:

Postoperative complications which follows appendicectomy are not common & it reflect the level of peritonitis that is present during the time of surgery and the diseases which may be predisposed to complications.

There are various types of complications that occurred after the appendicectomy surgery.

Of them, the commonest complications are fever and surgical site infection. Post-operative complications of appendicectomy have wide range of presentation from fever to fecal fistula.

In this study the patients presenting with features of post-operative complications of appendicectomy will undergo detailed history taking, clinical examination & investigations like complete blood count, blood sugar, urea & lipid profile, serum creatinine, Xray chest and wound pus culture sensitivity.

The study purpose was to assess the age distribution, sex distribution & to discuss various types of complication.

METHODS:

100 cases that have presented with features of post-operative complications of appendicectomy in the department of surgery, Tirunelveli Medical College & Hospital were evaluated during the study period from April 2012 to October 2013.

RESULTS:

Our study consisted of randomised selected 100 patients who presented with postoperative complications of appendicectomy.

The commonest postoperative complications of appendicectomy is fever, it constitutes of about 73% cases.

The second most common postoperative complications of appendicectomy is surgical site infection, it constitutes of about 37% cases.

Most common age group, in which post-operative complications seen, is > 20 years.

The second most commonly affected age group is 20-30 years.

The surgical site infections are most commonly due to E.coli, it constitutes of about 64.86% cases having SSI.

The next causative organism is Klebsiella sp, which constitutes about 8.1% cases.

The remaining cases show no growth in culture.

The common day of presentation of fever is 2^{nd} POD with 57.3% cases.

In this study 97% case of postoperative complications of appendicectomy occurs after emergency surgeries.

Keywords:

Post-operative complications, Emergency and Elective appendicectomy, Fever, Surgical site infections.

CONTENTS - TABLE

ABBREVIATIONS USED IN THE STUDY - LIST

1. POD – Post operative day.
2. C – Centigrade.
3. CT – Computerised Tomography.
4. ECG-Electrocardiogram
5. Hg – Mercury.
6. mm – Millimetre.
7. min – Minute.
8. USG – Ultra soonography.
9. W – Watt.
10. WBC – White blood cell count.
11. SSI – Surgical Site Infection.
12. ASIS – Anterior Superior Iliac Spine
13. RIF – Right iliac fossa

INTRODUCTION OF POSTOPERATIVE COMPLICATIONS OF APPENDICECTOMY

Acute appendicitis is one of the commonest causes of acute abdomen in young individual and the associated symptoms and signs have become a paradigm for clinical teaching.

Appendicitis is more common that appendicectomy is the most frequently performed urgent abdominal operation and is often the first major procedure performed by a surgeon in training.

Approximately seven percentages of people in Western nations have appendicitis and about two lakhs appendectomies for acute appendicitis are performed per year in the United States.

The incidence, which steadily decreasing over the last 25 years in developed world.

The incidence in the developing countries, which in the past was low, has been rising in proportion of economic gaining and lifestyle changes.

The treatment of choice for acute appendicitis is appendicectomy.

Urgent surgery is needed to reduce the increased morbidity and mortality of peritonitis.

Postoperative complications which following the surgery appendicectomy are not common and it shows the level of peritonitis that was present during the time of surgery and it may leads to complications.

Wound infection is the commonest of all the postoperative complication, occurring in 5–10% of all the patients. This presents with pain and erythema of the wound on the 4^{th} or 5^{th} postoperative day.

Treatment is by drainage of wound and appropriate antibiotics when required.

Intra-peritoneal abscess is a uncommon complication after appendicectomy with the use of peroperative antibiotics.

Postoperative aomplications such as fever, malaise and anorexia developing five to seven days after surgery is suggestive of an intraperitoneal collection.

Ileus for more than 4 or 5 days, especially with presence of fever, is indication for an intra-abdominal sepsis.

With postoperative analgesia & physiotherapy, when appropriate, reduce the incidence of respiratory complications.

The most common late complication of appendicectomy is instestinal obstruction.

AIMS & OBJECTIVES OF POST OPERATIVE COMPLICATIONS OF APPENDICECTOMY

1. Study of age distribution of appendicectomies post-operative complications.
2. Study of sex distribution of appendicectomies post-operative complications.
3. Discussion of various types of post-operative complications of appendicectomy.
4. Discussion of various organisms involved in surgical site infections in post operatively in appendicectomy.
5. To find out the most common post-operative complications of appendicectomy.
6. To find out the most common post-operative complications of appendicectomy in various types of surgeries.

REVIEW OF LITERATURE

HISTORICAL BACKGROUND:

The appendix is present in the right lower abdominal quadrant, its function in disease however has remained silent.

Egyptians two thousand years before of the Christian era mentioned the presence of the appendix at post-mortem preservation and documented it as the "worm" of the bowel.

The appendix along with other viscera was preserved during mummification.

In 1492, Leonardo da Vinci was the first to show the appendix in drawings and called it as orecchio, means little ear.

In 1521, Berengario da carpi, Professor of anatomy at Bologna, was the first person to describe the appendix.

In 1543, the father of modern anatomy Andreas Vesalius, showed the appendix but didn't descried it.

In 1544, Jean Fernel[11], the French physician, was first to describe appendicitis.

In 1652, Von Hilden, also describe appendicitis.

In 1711, Lorenz Heister[12], a professor in medicine and also a practicing surgeon working at the Universities of Altdorf-Nürnberg and Helmstedt in Germany,describes the perforative appenditis with abscess formation unequivocally.

In 1719, Giovanni Battista Morgagni, give first detailed description of appendix.

In 1736, Claudius Amyand[14], did first appendicectomy at St. George's Hospital, London, but in a case of inguinal hernia.

In 1759, Mestivier, describes the appendicular perforation by a pin and also he considers perforation was the cause of abscess formation.

In 1767, John Hunter, describes the gangrenous appendix in autopsy.

In 1812, John Parkinson, first to describe fecolith, in a 5 year old child with perforative appendicitis by autopsy.

In 1824, Louyer-Villemay, describes fatal gangrenous appencitis in 2 young men and first to describe acute suppurative appendicitis.

In 1830, Goldbeck, describes about the acute suppurative appendicitis and first to use the terminology perityphlitis.

In 1838, Stokes, used very large doses of opium for treating the inflammation, which occurs intraperitoneally.

In 1839, Thomas Addison and Richard Bright, describes the symptoms of appendicitis and stated that appendicitis was the cause for most of the inflammations in the right iliac fossa.

In 1839, A.Grisolle, drains the intraabdominal abscess following the fluctuation.

In 1846, Volz, he identifies the cause of right lower quadrant inflammation as appencitis.

In 1883, Abraham Groves removes a gangrenous appendix but published it only in 1934.

In 1883, Fergus from Canada, has done the first elective appendicectomy[15].

In 1884, Krönlein,was the firstpublishedaccountof appendicectomy.

In 1885, Charter-Symonds, did removal of fecolith extra peritoneally.

In 1886, Reginald Heber Fitz, Harvard University's pathologist, was the first to use the term appendicitis and did early removal of appendix.[13]

Fitz mentioned about the frequent abscesses in the RIF were not due to typhilitis, perityphilitis or epityphlitis but it was due to perforation of the an appendix.

In 1886, R.J. Hall removes appendicular perforation in an irreducible inguinal region hernia with pelvic abscess.

In 1886, John Homans, operated an eleven year old boy, drains the abscess with better recovery.

In 1887, Edward R. Cutler performed one of the first unruptured appendectomies which were reported in 1889.

In 1889, Charles McBurney, describes the abdominal point tenderness (Mc Burney's point). It was reported as an early operative intervention in cases of appendicitis which was presented before the New York Surgical Society.

In 1894, Charles McBurney, describes gridiron incision (McBurney's incision[17]) to Chicago Medical Society.

In 1894, Lewis L. McArthur, published his vertical midline incision technique.

In 1895, G.R.Fowler, introduced cuffing of appendicular stump.

In 1895, R.H.M. Dawbarn introduced invagination of appendicular stump to post-operative fistula.

In 1897, William Henry Battle introduced a vertical incision through the lateral edge of the right rectus sheath; others also advocated it, and incision sometimes is referred to as Battle-Jalaguier-Kammerer incision.

In 1898, A.C.Bernays, reported 71 appendicectomies without mortality.

In 1899, Harrington, Weir, and Fowler, described medial extension of gridiron incision by dividing lateral portion of rectus sheath (Fowler-Weir extension).

In 1904, John B. Murphy[18], reported 2000 appendicectomies without mortality.

In 1905, A.E.Rockey and G.G.Davis, describes the transverse skin incision called as Rockey Davis incision.

In 1921, P.Masson, describes neuroma of the appendix and relationship between neuro endocrine cells and origin of carcinoid tumors.

In 1936, A.J.E.Cave, describes appendiceal duplication and abnormalities.

In 1951, D.C.Collins, describes appendiceal agenesis.

In 1977, de kok, did laparoscopic aided appendicectomy with mini laparotomy.

In 1982, A.P. Dhillon, L. Papadaki, J. Rode, describes the presence of sub-epithelial neuro endocrine cells and immunoreactivity for serotonin.

In 1983, Semm, did the laparoscopic appendicectomy.

LAPAROSCOPY AND APPENDICITIS:

Reduction in the size of incisions was a dream of surgeons for years.

Hippocrates describes a rectoscope in four hundred BC.

Abukasim, an Arab doctor, developed an illuminated speculum by light reflectors. They has limited applications due to the heat produced by candles and the artificial light sources were transmitted in to the instruments and resulted in burns.[21] George Kelling,[20] coined the termcoelioskope, the technique that used a cystoscope for examinination of the abdominal cavity in dogs and reported at the Biological and Medical Society Meeting held at Germany, in September 1901.

In 1911, the first laparoscopy on man was demonstrated by Hans Christian Jacobeus.

Von Ott visualised the abdominal cavity of a woman who was pregnant.

In 1912, Nordentoffsimilar to Kelling and Jacobaeus describes by viewing the female pelvis in a cadaver, inTrendelenburg position.

In 1924, Zollikofer was the first to use carbon dioxide forcreatingpneumoperitoneum.

In 1934, Ruddock used air for pneumoperitoneum and employed local anaesthesia. He designed a single puncture operating laparoscope and it accompanies instruments with which biopsies could be taken.

In 1938, Verres introduced a pneumoperitoneum needle with a spring-loaded inner blunt probe surrounded by a sharp outer sleeve[24].

In 1952, thelight Source was introduced by Fourestier, GladuVulmiers of Germany, and a method of transmitting an intense light along with a quartz rod. This removed danger of accidents due to electric faults and heat.

In the same year, Hopkins and Kampanyintroducedfibre optics to endoscopy.

In 1972, the First International Congress on Gynaecological Laparoscopy took place in Las Vegas.

Up to the 1970s, laparoscopy was mostly used by gynaecologists and gastroenterologists for the purpose of diagnosis only. Therapeutic laparoscopy was introduced by gynaecologists1970. [22]

Rapid technical development in miniaturised surgical tools, fibre optics, and video systems, which were the new developments in minimally invasive surgery. These methods reduce the post-operative complications of lap and minimally invasive surgery which was used commonly by general surgeons around the world.

On 13 September 1983 the gynaecologist Professor Kurt Semm performed the world's 1st laparoscopic appendicectomy at the German University of Kiel. Increased interest in the field of laparoscopy among general surgeons developed only after the French gynaecologist Mouret performed in 1987 the first known lap cholecystectomy is done by using four trocars. [24]

Götzet al[25] applied laparoscopic appendicectomy procedure in 1987.

A low incidence of late complications such as adhesive intestinal obstruction, which were common among patients with conventional appendicectomy and conventional abdominal surgeries.[26]

Natural orifice Trans-luminal endoscopic surgery is the newer technique in the field of surgery.

Various approaches for appendicectomy have been tried.

Transgastric and transvaginal route have been tried.

ANATOMY OF VERMIFORM APPENDIX: [45]

The vermiform appendix is a narrow, tubular structure which arises from the posteromedial caecal wall, two centimeter (cm) below the end of the ileum.

It occupies several positions. It may be retrocaecal(behind the caecum), retrocolic(lower ascending colon), pelvic or descending (over the pelvic brim, in relation to the right uterine tube and right ovary in females).

These are the common positions seen.

Other positions are occasionally seen especially when there is a long appendix mesentery allowing greater mobility. These include subcaecal(that is below the caecum); preilial (anterior to the teminal ileum); postileal (behind the teminal ileum).

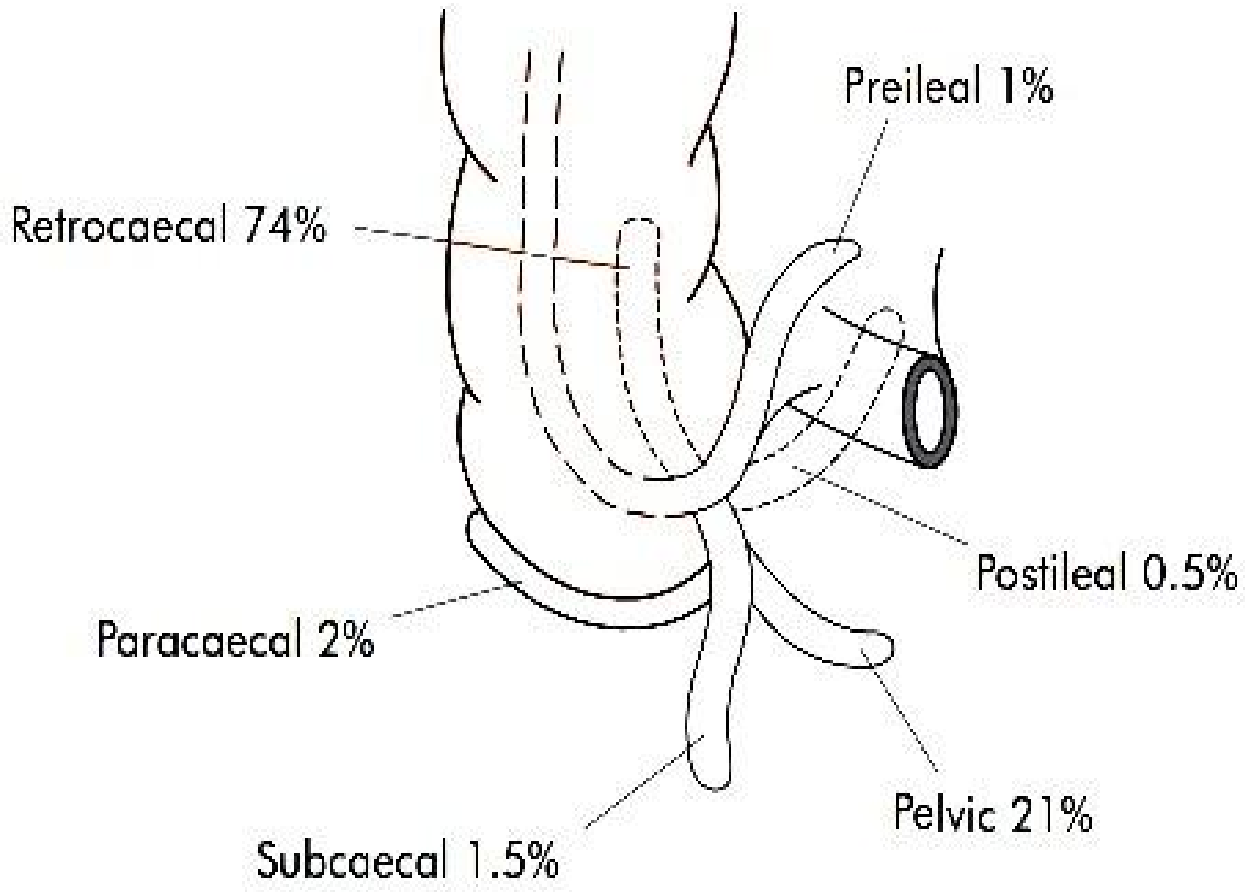


Figure 1: Various position of appendix

The three taeniae coli in the ascending colon and also in the caecum converge at the base of the appendix, which merges into its longitudinal muscle. The anterior caecal taenia is used for tracing the appendix.

The appendix varies from two to twenty cm in length. It is often relatively lengthier in children and may get atrophy or may get shorten after adult life.

It is connected with the mesoappendix in the ileal mesenteries lower part.

Mesoappendiceal fold is triangular, extending to the appendicular tip along the whole viscus.

The lumen of the appendix is small, opens in the caecum through an orifice which lies below and posterior to the ileo-caecal opening.

The orifice is mostly protected by a semilunar mucosal fold which forms a valve.

The lumen may be opened in early childhood and is partially or fully obliterated in the later life.

The appendix contains numerous lymphoid tissue and they tend to decrease in size in adulthood.

Vascular supply and lymphatic drainage:

Appendicular artery:

The appendicular artery, which is a branch from the ileocolic artery – lower division, which runs at the back of the terminal ileum and it, enters the mesoappendix.

Appendicular artery gives a recurrent branch, which forms anastomoses at the base of the appendix with one of the branch of the posterior caecal artery.

The anastomosis is extensive.

The appendicular artery while reaching the tip of the organ, at first it goes near to the appendix and then moves towards the edge of the mesoappendix.

The terminal part of the appendicular artery lies on the wall of the appendix and may be thrombosed in case of appendicitis, which leads to distal gangrene or necrosis.

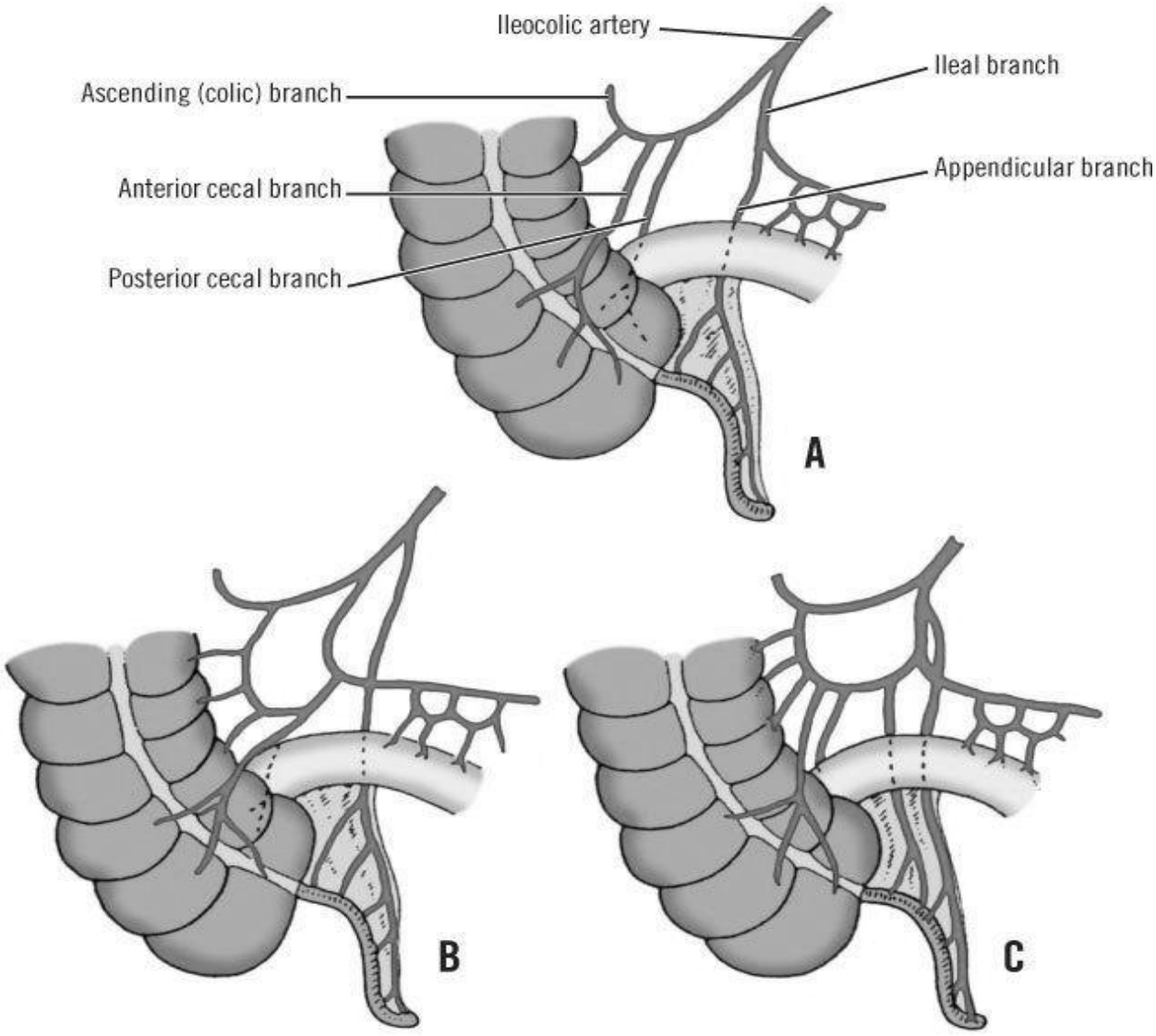


Figure 2: Blood supply of appendix

Accessory arteries are common, and many possess two or more arteries of supply.

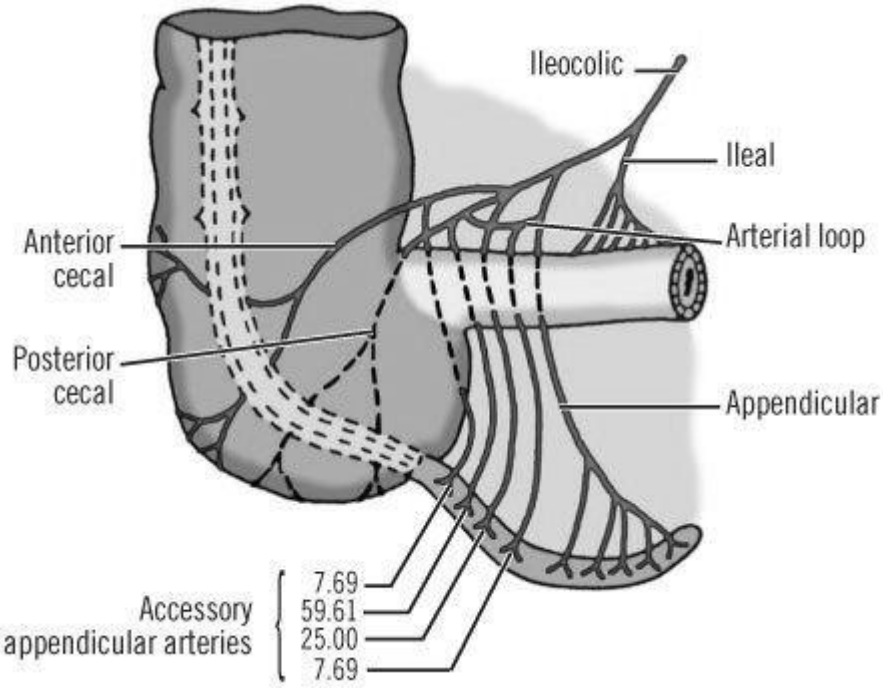


Figure 3:Accesory appendicular artery.

Appendicular veins

The appendix is drained by one or more appendicular veins into the posterior caecal or ileocolic vein and finally drains in the superior mesenteric vein.

Lymphatic drainage:

Lymphatic vessels in the appendix are many and there is more lymphoid tissue in its walls.

From the apex and the body of the appendix contains eight to 15 vessels arises from the mesoappendix, and they are occasionally interrupted by one or more nodes.

They unite to form three or four larger vessels which run into the lymphatic vessels draining the ascending colon, and drains into the inferior and superior nodes of the ileocolic chain.

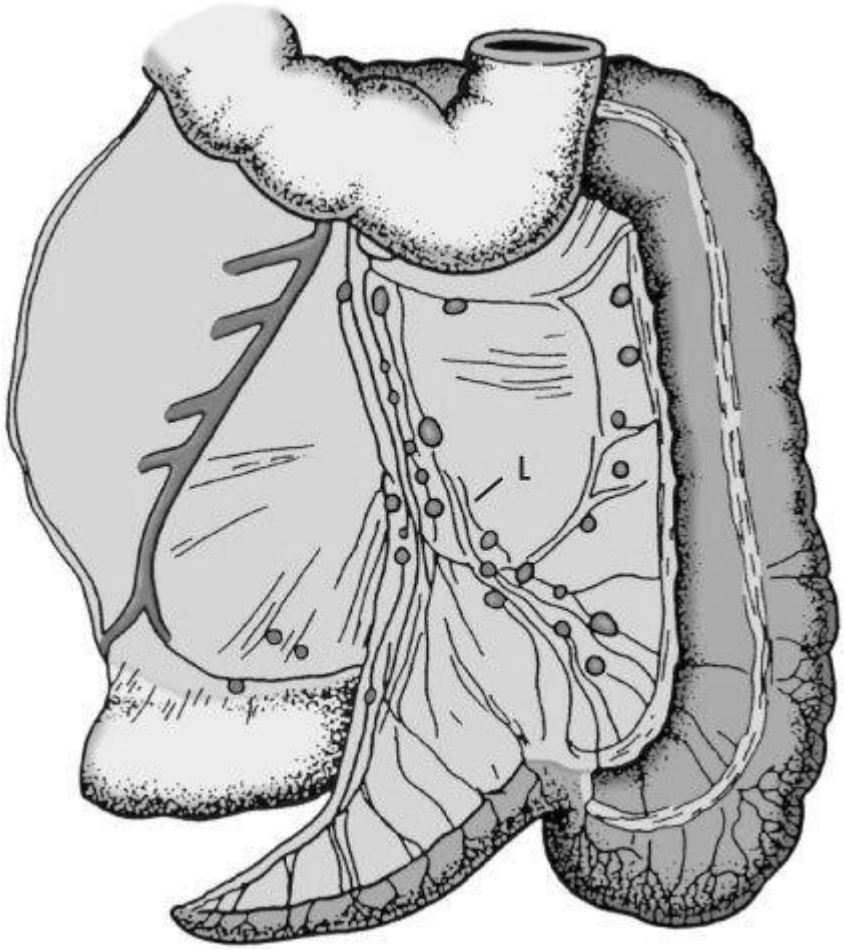


Figure 4: Lymphatic drainage of the appendix

Innervation:

The appendix and its overlying visceral peritoneum - innervated by both sympathetic and parasympathetic nerves - superior mesenteric plexus.

Visceral afferent fibre carries sensory supply from distension and pressure leading to the symptoms of pain which is felt at the initial stages of the inflammation of the appendix.

Due to the structures which are derived from the midgut, these sensations are initially poorly localised, and referred in the central (periumbilical) part of the abdomen.

It is not until the parietal tissues adjacent to the appendix become involved in the inflammatory process, the somatic nociceptors are stimulated, and there is a change in the nature and localization of pain.

Mesoappendix:

It is the mesentery of the appendix, which is a triangular fold of peritoneum around the vermiform appendix.

It is attached to the lower end of the mesentery in the posterior surface of the small intestine about 1.7 cm from the ileocaecal junction.

It reaches the tip of the appendix but few times fails to reach the distal third, in which case a vestigial low peritoneal ridge containing fat is present over the distal third.

Mesoappendix also encloses the blood vessels, nerves and lymph vessels of the vermiform appendix, and usually contains a lymph node.

It is also called as mesenteriole (since it encloses the artery to appendix).

Microstructure of the appendix

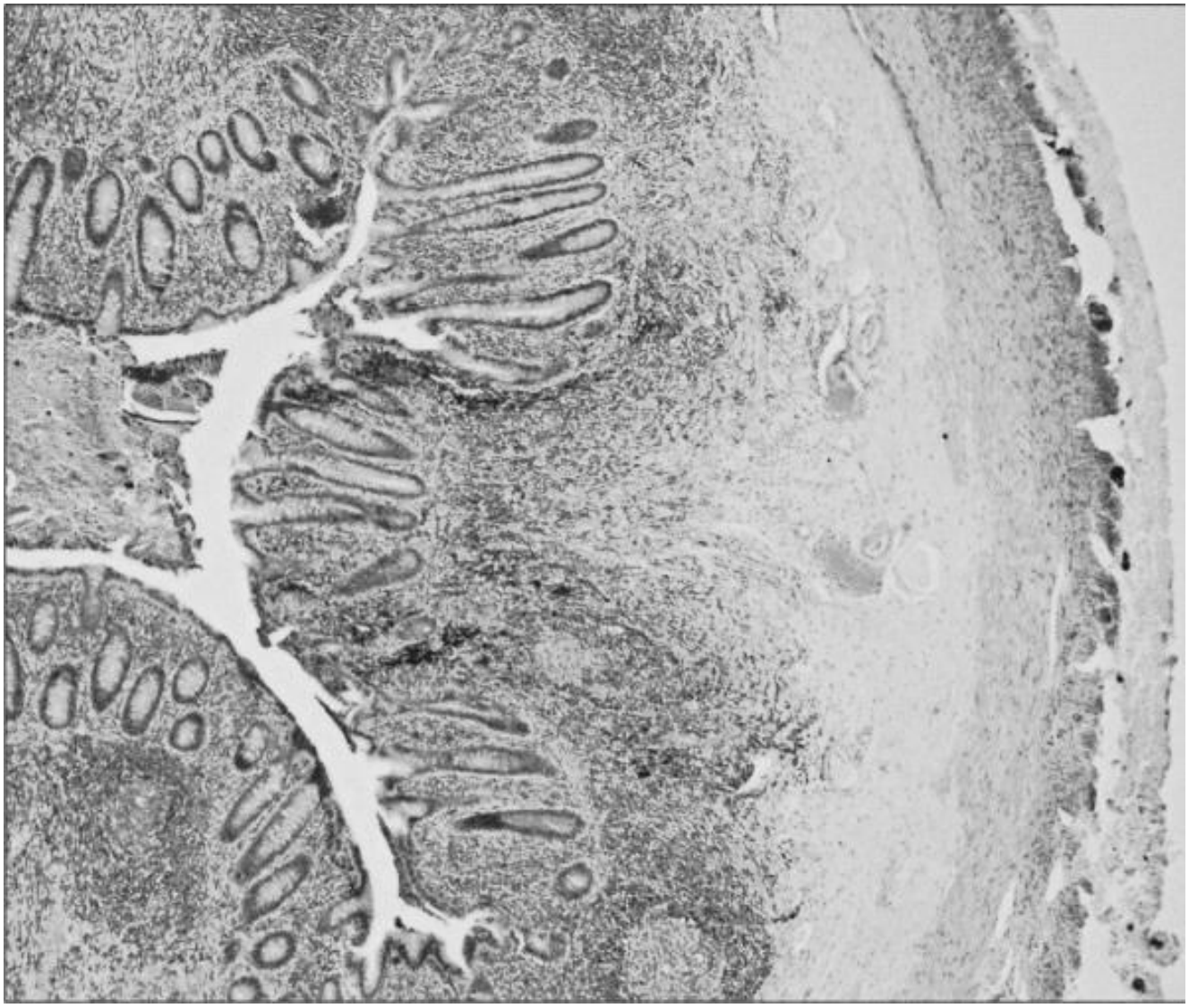


Figure 5: Normal histology of appendix

Serosa

It forms complete covering, except along the mesentery.

The longitudinal muscular fibres form a layer of uniform thickness, except over a few small areas, where both the muscular layers are deficientandleaving the serosal layer and submucosal layer in contact.

Muscularis Externa

The muscularis externa have an outer longitudinal layer and inner circular layer of the smooth muscle.

The longitudinal fibre forms a continuous layer.

These were aggregated as longitudinal bands or taeniae coli.

At the base of the appendix, the longitudinal muscle gets thickened and forms the rudimentary taeniae, which are continuous with that of the caecum and colon.

Between the taeniae coli the longitudinal layer, which is thin and less than half of the circular layer in thickness.

Sub-Mucosa

The submucosa typically contains many large lymphoid aggregates that extend from the mucosa and obscure the muscularis mucosae layer: consequently this becomes discontinuous.

These lymphoid aggregates also lead to the mucosa to bulge into the lumen of the appendix, so that it narrows irregularly.

They are absent at birth but accumulate over the first 10 years of life to become a prominent feature.

The submucosal lymphoid tissue frequently exhibits germinal centres within its follicles, indicates the B-cell activation, as like secondary lymphoid tissue elsewhere.

In adults, the normal layered structure of the appendix is lost and the lymphoid follicles atrophy and are replaced by collagenous tissue.

In the elderly, the appendix may be filled with fibrous scar tissue.

Mucosa

The mucosa is covered by columnar epithelium and M cells which are present in the epithelium that overlies the mucosal lymphoid tissue.

Glands or crypts are few in number and less densely packed.

They penetrate deeply into the lymphoid tissue of the mucosal lamina propria.

EMBRYOLOGY OF THE APPENDIX[46]

The appendix develops as the terminal portion of the embryonic cecum.

The appendix becomes a distinguishable organ by its failure to enlarge as fast as the proximal cecum.

There is a difference in rate of growth which continues in the postnatal life also.

At birth, the colonic diameter is 5 times bigger that of the appendix

In adults, it is 8.5 times bigger.[5]

The appendix is visible from the eighth week of gestation.

At first, it is projected from the apex of the cecum.

As the cecum grows, the appendix moves medially towards the ileocecal valve.

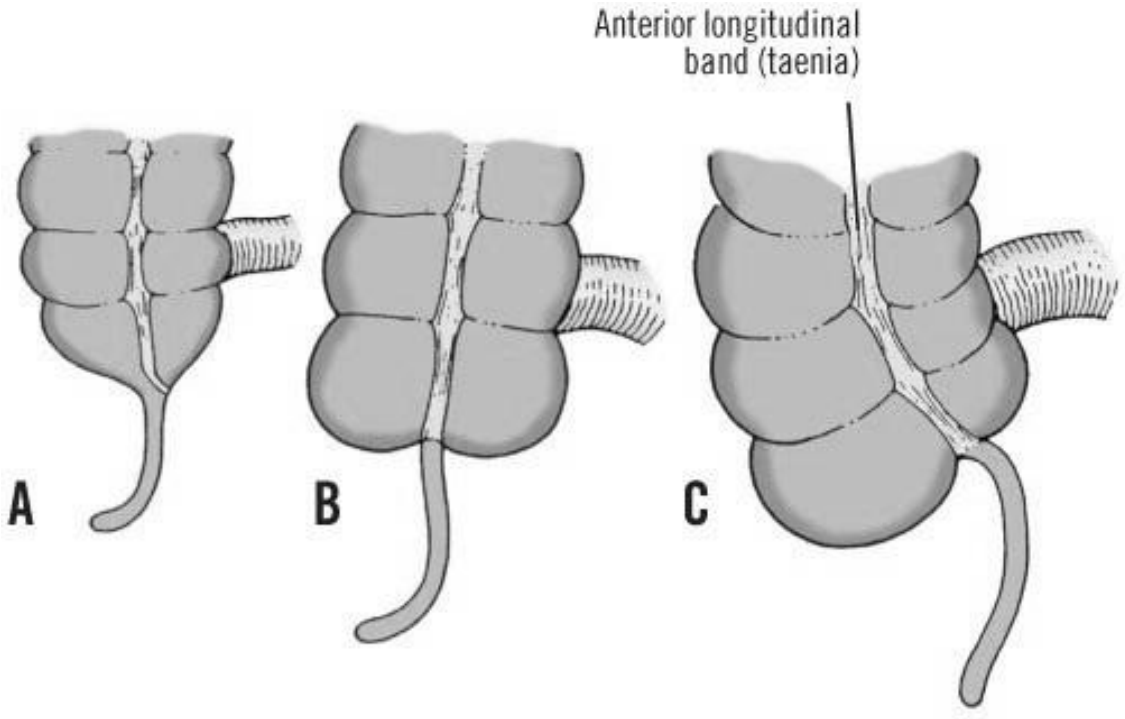


Figure 6: Three types of cecum and appendix. A and B – Infancy, C – Adult.

The taenia in the longitudinal muscle coat of the colon arises from the base of the appendix, showing the similar displacement.

Congenital absence of the appendix is extremely rare.

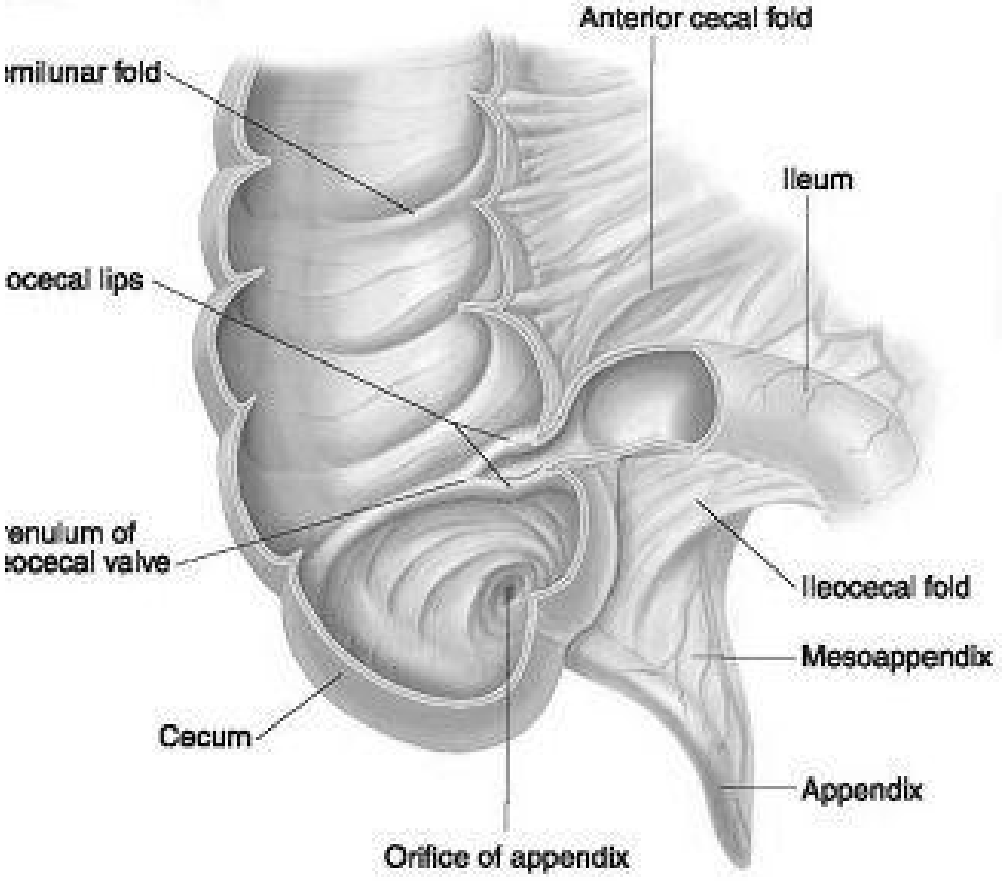


Figure 7: Orifice of the appendix

PATHOLOGY [47]

Morphology

At initial stages, a scanty neutrophlic exudate may be found in the mucosa, submucosa and muscularis propria.

Subserosal vessels are congested; often there is a perivascular neutrophilic infiltrate.

The transformation of normal glistening serosa into a dull, granular, red membrane is due to inflammatory reaction; this transformation is due to early acute appendicitis.

At the later stages, a fibrino-purulent reaction over the serosa is due to prominent neutrophilic exudate generation.

The criteria for the diagnosis of acute appendicitis - neutrophilic infiltration of the muscularis propria.

Neutrophils along with ulcerations are also present within the mucosa.

Drainage of an exudate into the appendix from gastro intestinal infection may also induce a mucosal neutrophils infiltrate; diagnostic criterion is the evidence of muscular wall inflammation.

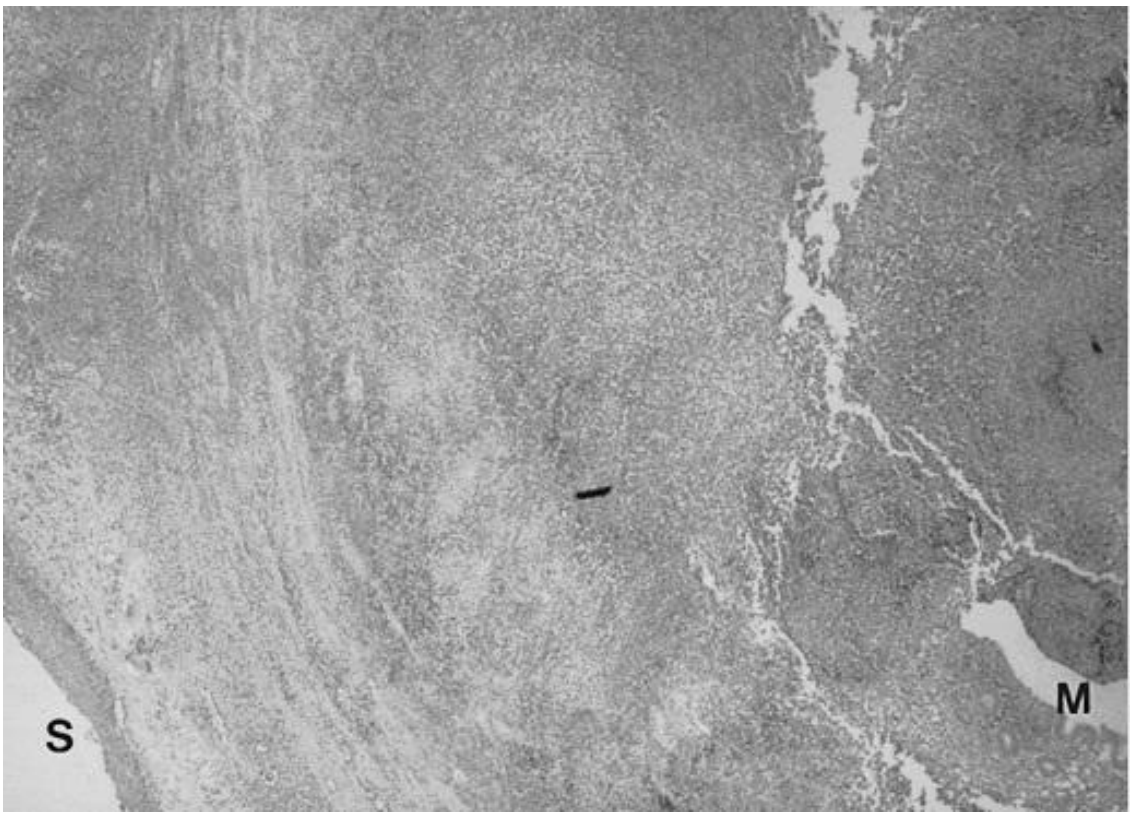


Figure 8: Histology of inflamed appendix

Incidence

The overall risk for appendicectomy is 12% for men and 25% for women, with approximately seven percent of all people undergoing appendicectomy for acute appendicitis.

Over the series of 10 year period from 1987 to 1997, the overall appendicectomy rate reduces which are parallel to a decrease in incidental appendicectomy.

Appendicitis is most commonly seen in patients in their 2^{nd} to 4^{th} decades of life, the mean age is 31.3 years and median age is 22 years.

There is a mild male to female predominance (M: F ratio 1.2 to 1.3:1). [48, 49]

There is an increase in appendicitis incidence, in the first half of this century, particularly in Europe, America and Australia; with up to 16% of the population were undergoing appendicectomy.

In the past 30 years there is decrease in the incidence of these nations, such that the lifetime risk of an individual, of appendicectomy is 8.6% and 6.7% among males and females respectively.

The number of operations annually in England and Wales declined from 113 000 in 1966 to 48 000 in 1990, while in Sweden there has been an annual decrease of 17% in the numbers of appendicectomies performed between 1987 and 1996.

Acute appendicitis is relatively an uncommon in infants and increasing in incidence of childhood and early adult life, which attains a peak incidence in the

teens and early 20s. After middle age the risk for developing appendicitis in the future is very less.

The incidence of appendicitis is among males and females before puberty.

In teenagers and young adults the male to female ratio increases to 3:2 at age 25; in elderly the greater incidence in male declines.[50]

Aetiology

There is no definitive theory regarding the acute appendicitis.

Decreased consumption of dietary fibre and increased refined carbohydrates may be important.

As like colonic diverticulitis, the incidence of appendicitis is low in societies with a high dietary fibre intake.

The developing nations, which are following more refined Western nationed diet, the incidence rises.

There is a decrease in the incidence of appendicitis in Western natios observed in the past 30 years.

No reason have been explained for these paradoxical changes; however, improving the hygiene and changes in the pattern of childhood gastrointestinal infection due to increased use of antibiotics may be responsible.[50]

Intestinal parasites, mainly Oxyuris vermicularis (pinworm), it proliferates in the appendix and occluding the lumen.

Pathogenesis

Obstruction in the lumen is the usual factor in case of acute appendicitis. Faecoliths are the commonest cause of appendiceal obstruction.

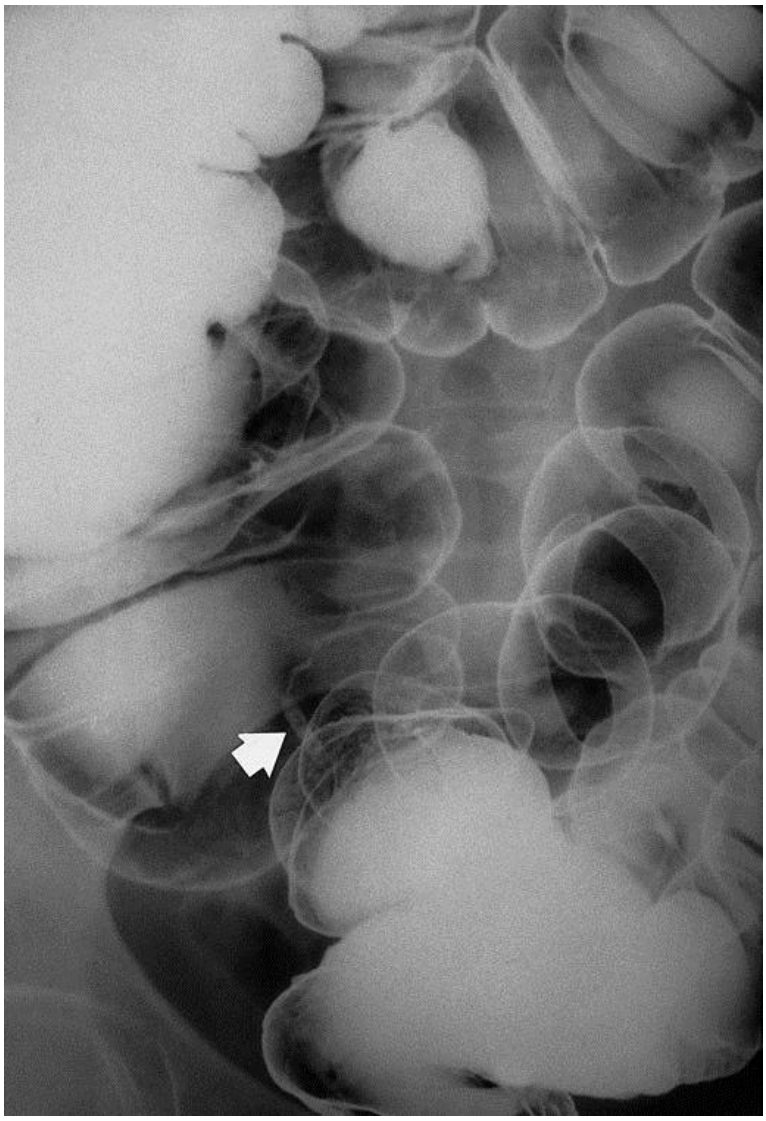


Figure 9: Barium enema radiograph demonstrating faecoliths ofthe appendix

Least common causes are lymphoid tissue hypertrophy, barium from previous x-ray studies, tumors, vegetable and seeds of the fruits taken, and the intestinal parasites.

The obstructing frequency increases with the severity of the inflammatory process.

Faecoliths are seen in 40% of acute appendicitis, 65% of cases of appendicitis without rupture have gangrene, and nearly 90% of cases of gangrenous appendicitis with rupture.

There is a sequence which leads to appendicular rupture.

The obstruction which is proximal in the appendiceal lumen leads to closed-loop obstruction, and continuous secretion by the mucosa which is normal in appendix rapidly produces distension.

The capacity of the normal appendiceal lumen is only 0.1 millilitre (mL).

Secretion is very less 0.5 mL of fluid, when there is obstruction the intraluminal pressure increases to 60 cm H_2O.

Distension of the appendix leads to stimulation of visceral afferent fibres for stretch sensation, producing vague, dull, pain which is diffuse in the abdomen or lower epigastrial nerve endings.

Peristalsis can also be stimulated by distention which occurs suddenly, cramp pain may be superimposed with that of visceral pain initially in the process of appendicitis.

Distension is continued with continues mucosal secretion and also from fast multiplication of the floral bacteria of the appendix.

Distension of these magnitudes causing nausea and reflex vomiting, and the visceral pain diffusely becomes more aggravated.

As with increase in pressure in the organ, venous pressure is also increased.

This leads to capillaries and venules to get occluded, but inflow of arteries continues, this resulting in engorgement of veins and vascular congestion.

The inflammatory process very soon involves the appendiceal serosa and parietal peritoneum in this region, producing the classical shifting in the pain to the right iliac fossa.

The mucosa of the alimentary tract, inclusion of the appendix, is more susceptible to impairment of blood supply, so its integrity is compromised very early in the process, allowing for the bacterial invasion.

As distension is progressed upon the venous return and the arteriolar inflow, those areas with the poor blood supply suffers most, which leads to development of ellipsoidal infarcts in the antimesenteric border.

As distension progresses leads to bacterial invasion, compromise of vascular supply occurs and infarction progress, leads to perforation to occurs, usually in one of the infarcted areas along the antimesenteric border.

Perforation usually occurs just distal to the point of obstruction rather than at the tip because of the intraluminal tension in the appendiceal lumen.

This sequence is not inevitable, however, and few episodes of acute appendicitis may apparently subside spontaneously.

Many patients who have acute appendicitis give a history of previous similar during surgery, but a less severe attack of right lower quadrant pain.

Pathologic examination of the removed appendix from these patients, which often shows thickening and scarring, which suggests old, healed, acute inflammation.[51-53]

BACTERIOLOGY

AEROBIC FACULTATIVE	ANAEROBIC
Gram – negative bacilli	Gram – negative bacilli
E – coli (More common)	Bacteroidesfragilis (More common)
Pseudomonas aeruginosa	Bacteroides species
Klebsiella species	Fusobacterium species
Gram – positive cocci	Gram – positive cocci
Streptococcus species	Peptostreptococcus species
Enterococcus species	Gram – positive bacilli
	Clostridium species

Table 1: Common organisms seen in patients with acute appendicitis.[54]

Presentation

In 1905, Murphy describes the sequence of symptoms of pain, nausea and vomiting with fever and exaggerated local tenderness in the position of the appendix.[55]

The classical presentation of acute appendicitis is cramping pain, intermittent abdominal pain, which is due to appendiceal luminal obstruction.

The pain may be a periumbilical or diffuse pain and which can be difficult to localise.

This is usually followed by nausea but vomiting may be present.

If nausea and vomiting appears before the pain, patients are more likely to have other causes of abdominal pain, gastroenteritis.

Characteristically, the pain migrates to the RIF which are due to transmural appendicular inflammation, which leads to peritoneal lining inflammation of the RIF.

This occurs within twelve to twenty four hours of the initiation of symptoms.

The pain character is changed from colicky and dull pain, to a constant and sharp pain.

Any movement or doing a Valsalva maneuver leads to worsening of pain, so the patient typically wishes to lie still.

Patients may be reported with low-grade fever up to 38.3°Centigrade (C).

Patients who are presented as appendicitis are commonly reported to have anorexia; appendicitis is not likely in those patients with a normal appetite.

The classical acute appendicitis presentation is not seen in all patients.

Patients may have no symptoms or may have few of the symptoms.

For instance, they may or may not notice or recall the initial colicky pain.

When it becomes constant pain, it may be localised to other quadrants of the abdomen due to an alteration in appendiceal anatomy as in pregnancy or may be due to malrotation.

In case of retrocecal appendicitis, the pain may not be localised until generalized peritonitis develops from a perforated appendicitis.

Occasionally patients may have urinary symptoms or even microscopic hematuria, which is due to the inflammation of periappendiceal tissues adjacent to the ureter or the urinary bladder, and this may be misleading.

An increase in frequency of bowel movements may be present due to appendiceal inflammation, which irritates the adjacent rectum.

An appendix which is inflamed is in the pelvic region may not produce somatic pain in the anterior abdominal wall but can instead leads to discomfort in the suprapubic region with tenesmus.

In these circumstances, tenderness is elicited on digital rectal examination and it is recommended that a digital rectal examination should always be performed on every patient who are presenting with acute lower abdominal pain.

Appendicitis which is more common and a high index of suspicion for appendicitis to be made in all patients with abdominal pain.[56]

DIAGNOSIS

History and Physical Examination[56]

The diagnosis of a disorder begins with a detailed history taking and a physical examination.

The patient is asked for the characteristic symptoms of acute appendicitis, but the surgeon should not determine the course of treatment by the absence of many of the symptoms.

Many patients with acute appendicitis may not have a characteristic history.

The DD of appendicitis is more extensive, the patient should be enquired about those symptoms that may lead to a suggestion an alternative diagnosis.

Surgeons should also remember that a previous appendicectomy not always definitively exclude the diagnosis of appendicitis, the "stump appendicitis" (appendicitis in the remaining part of appendiceal stump which was left after appendicectomy), even though it is rare but has been described.[57]

On inspection, a patient looks ill and may have slightly increase in temperature and pulse rate.

They often lie down still to avoid the irritations of peritoneum which are caused by some movements.

The surgeon must always examine the entire abdomen of the patient systematically, starting from the left upper quadrant, which is away from the patient's described pain.

Maximum tenderness is typically seen in the RIF, at or near McBurney's point, which is located 1/3 of the way from the ASIS to the umbilicus.

This tenderness is usually associated with localised muscle rigidity and signs of inflammation of peritoneum, including shake, rebound, or tap tenderness.

RIF tenderness is the most constant of all signs of acute appendicitis; [58, 59] its presence must always raise the suspicion for appendicitis, even though there is absence of other signs and symptoms.

Due to the various appendicular anatomic locations, there is more possibility for the tenderness to be present in the right lumbar or right upper quadrant, the left lower quadrant, or the suprapubic region.

Multiple signs are used in physical examination for diagnosing acute appendicitis.

1. Rovsing's sign, the pain is felt in the RIF while palpating the left lower quadrant; this is the evidence of localised peritoneal inflammation in the RIF.
2. Psoas sign, pain is relieved when the thigh is flexed at the right hip, which can occur in an appendix which is located retrocecally due to inflammation of the psoas muscle.
3. The obturator sign (Zachary Cope), pain with rotation of the flexed right thigh internally, shows inflammation adjacent to the obturator muscle in the pelvis and is due to spasm of the obturator internus.
4. Dunphy's sign, increases in pain during coughing.

Typically, there are 2 acute appendicitis clinical syndromes, acute catarrhal (non-obstructive) appendicitis and obstructive acute appendicitis.

The latter is more characterised by an acute course.

The onset of symptoms is more rapid, and there may be abdominal pain which is generalised from the initial stage.

The temperature may or may not be normal and vomiting may be common, presenting as a case of acute intestinal obstruction.

After recognition, an urgent opertional intervention is required because of the perforation due to rapid progression.

If perforation occurs in the appendix, abdominal pain becomes more diffuse, and the abdominal muscles spasm increases, producing abdominal rigidity.

The heart rate increases, with an elevated temperature above 39°C.

The patient may be appearing ill and requires a fluid resuscitation and antibiotics before the induction of anesthesia.

The pain may improve to some extent after rupture of the appendix, although a true pain-free interval is not common.

Laboratory Studies

Laboratory studies are more useful in the appendicitis diagnosis, but there is no single definitive test.

A WBC is more useful laboratory test.

The WBC is slightly increases in non-perforated appendicitis, but may be increased to significant value in the presence of perforation.

The surgeon must remember, the WBC may be normal in acute appendicitis patients, especially in early cases.

A serial WBC monitoring improves the accuracy of diagnosis, with a rise in value commonly seen in appendicitis patients.

Urinalysis may be performed for diagnosing other imporatnt causes for abdominal pain, ex. urinary tract infection and ureteral stone.

Significant hematuria along with the colicky abdominal pain may suggest an ureterolithiasis, and test directed towards this diagnosis is indicated.

A urinary tract infection is not uncommon in patients with acute appendicitis.

Its presence never excludes the diagnosis of acute appendicitis, but it should always be identified and treated.

Although pyuria suggests a urinary tract infection, in acute appendicitis, the urinalysis shows few white blood cells, which is due to inflammation of the ureter by the adjacent inflammed appendix.

Other laboratory tests are indicated.

In a woman of childbearing age, the urine human chorionic gonadotropin should be checked to rule out the possibility of ectopic or concurrent pregnancy.

Ectopic pregnancy is one of the causes of right lower quadrant pain, which needs emergent diagnosis and treatment.

Alvarado (Mantrels) score

Symptoms	Score
Migratory RIF pain	1
Anorexia	1
Nausea and vomiting	1

Signs	Score
Tenderness	2
Rebound tenderness	1
Elevated temperature	1

Laboratory	Score
Leucocytosis	2
Shift to left	1
TOTAL	10

Table 2: Scoring system in case of acute appendicitis

A score of 7 is strongly predictive of acute appendicitis.

Imaging Studies

The imaging modalities for diagnosis of acute appendicitis include plain X- ray, ultrasonography of abdomen (USG), and computerised tomographic scan (CT).

1. Before the use of the wide-spread use of modern techniques, plain abdomen xray films were often obtained in patients with abdominal pain.

Few helpful x-ray findings in acute appendicitis are

- Localised air fluid levels seen in the right iliac fossa.
- Localised ileus with gas seen in caecum, ascending colon or in terminal ileum.
- In retrocaecal appendicitis caecum may be distended with gas.
- Localised soft tissue shadow may be seen in the right lower quadrant.
- Presence of a faecolith.
- Gas in the appendix.
- Obliteration of the psoas shadow
- Altered right flank strips (flat line).
- Free intra peritoneal gas in case of perforated appendix.
- Deformity of the ceacal gas shadow is due to adjacent inflammatory mass (it is difficult to interpret; there may be disturbance of caecal gas from the intraluminal fluid or faeces).

2. Ultrasonography (USG) of the abdomen is most commonly used imaging modality for acute appendicitis. Findings that leads to suspicion of appendicitis include;

- Thickening of the appendiceal wall.
- Loss of appendiceal wall compressibility.

- Increased echogenicity of the surrounding fat around the appendix signifying inflammation
- Loculated periceacal fluid.

The advantages of the ultrasonography include its easy availability, as well as there is avoidance of ionizing radiation and also no side effects of intravenous contrast such as nephro toxicity and anaphylactic reactions.

In addition, ultrasonography (both abdominal and transvaginal) is useful in finding obstetric and gynecological causes of abdominal pain in women of childbearing age.

Ultrasound is highly an operator-dependent scan, however, and it usually cannot visualise the normal appendix.

3. Computed tomography (CT) is also another imaging modality for acute appendicitis.

   CT benefits are a high diagnostic accuracy for acute appendicitis and visualisation and diagnosis of many other causes of abdominal pain that can be differential diagnosis for appendicitis.

   The findings of appendicitis on CT include a dilated (more than 6 mm), a thick-walled appendix that usually not filled with enteric contrast or air, as well as the surrounding fat stranding which suggest inflammation.

   In prospective studies, CT has sensitivity and specificity of 0.94 and 0.95 respectively.[62]

CT thus has high negative predictive value, making it particularly useful in excluding appendicitis in patients, the diagnosis is in doubt. Appendicitis is highly unlikely, if the enteric contrast fills the lumen of the appendix and with no surrounding inflammation is present.

The clinician must remember, however, that CT performed early in the course of appendicitis may not show the typical radiographic findings.

In confusing cases, it is necessary to repeat the CT after 24 hours of observation.[50]

Diagnostic Laparoscopy:

Most patients with appendicitis can be accurately diagnosed based on history, physical exam, laboratory studies, and imaging techniques, there are a small number in which the diagnosis remains elusive.

For the patients, diagnostic laparoscopy can give both a direct examination of the appendix and a survey of the abdominal cavity to find other possible causes of pain.

We use this technique primarily for those women in childbearing age for which the preoperative pelvic ultrasound or CT scan fails to provide accurate diagnosis.

Concerns about the possible side effects of a missed perforation and peritonitis on future fertility prompt earlier intervention in this patient population.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis of acute appendicitis can be almost all causes of abdominal pain.

A useful rule is not to place acute appendicitis lower than second in the differential diagnosis of acute abdominal pain in a healthy person.

The diagnosis of appendicitis is almost difficult in the very young and in the elderly.

It is in these groups the diagnosis is often delayed and perforation occurs most frequently.

In infants, findings such as lethargy, irritability, and anorexia can be present in the initial stages, with vomiting, fever, and pain appears as the disease progresses.

In preschool aged children, the differential diagnosis also includes intussusception, Meckel's diverticulitis, and acute gastroenteritis.

Intussusception can be distinguished by the colicky pain, with intermittent pain-free periods, and there is absence of peritonitis.

Meckel's diverticulitis is not common, but it presents similar to that of appendicitis with the pain and tenderness typically localised in the periumbilical region.

Gastroenteritis may be difficult to differentiate from acute appendicitis in all age group.

Diarrhea and vomiting occurs in initial stages and persistent in gastroenteritis, and abdominal tenderness and peritoneal signs are not common.

In school going children, gastroenteritis presents with abdominal pain and diarrhea with no fever or leukocytosis.

The most common similarity for acute appendicitis in this age group is mesenteric lymphadenitis, which is be caused by enteric infections.[72]

In adults, consideration of other inflammatory conditions, such as pyelonephritis, colitis, and diverticulitis is important.

The pain and tenderness of pyelonephritis are located in the flank and are associated with high fever and white blood cell count also with pyuria.

Colitis is associated with diarrhea and the localisation of the pain typically outlines the trajectory of the colon.

In Crohn's colitis, diarrhea is not common, but there is often recurrence of symptoms.

The onset of right sided diverticulitis is often insidious and worsening over some period of days and also involving larger area of the right lower abdomen than the acute appendicitis.

The differential diagnosis for appendicitis for women in the childbearing age group is broad and have higher incidence of false positive diagnosis.

Pelvic pathology which is similar to acute appendicitis is pelvic inflammatory disease (PID), tubo-ovarian abscess, ruptured ovarian cyst or ovarian torsion, and ectopic pregnancy. [73]

Pelvic pathological conditions are typically differentiated from acute appendicitis by the absence of gastrointestinal symptoms.

Appendicitis is the most important non obstetric cause of abdominal surgical disease during pregnancy.

Diagnosis is difficult, symptoms of nausea, vomiting, and anorexia, and also elevated white blood cell count, is common during pregnancy.

The location of tenderness highly varies with gestational age.

After the 5th month of gestation, the appendix is shifted, above the iliac crest, superiorly, and the appendiceal tip is rotated, into the right upper quadrant, medially by the gravid uterus.

Ultrasound is used in both as the diagnosis and identifying the location of the inflamed appendix.

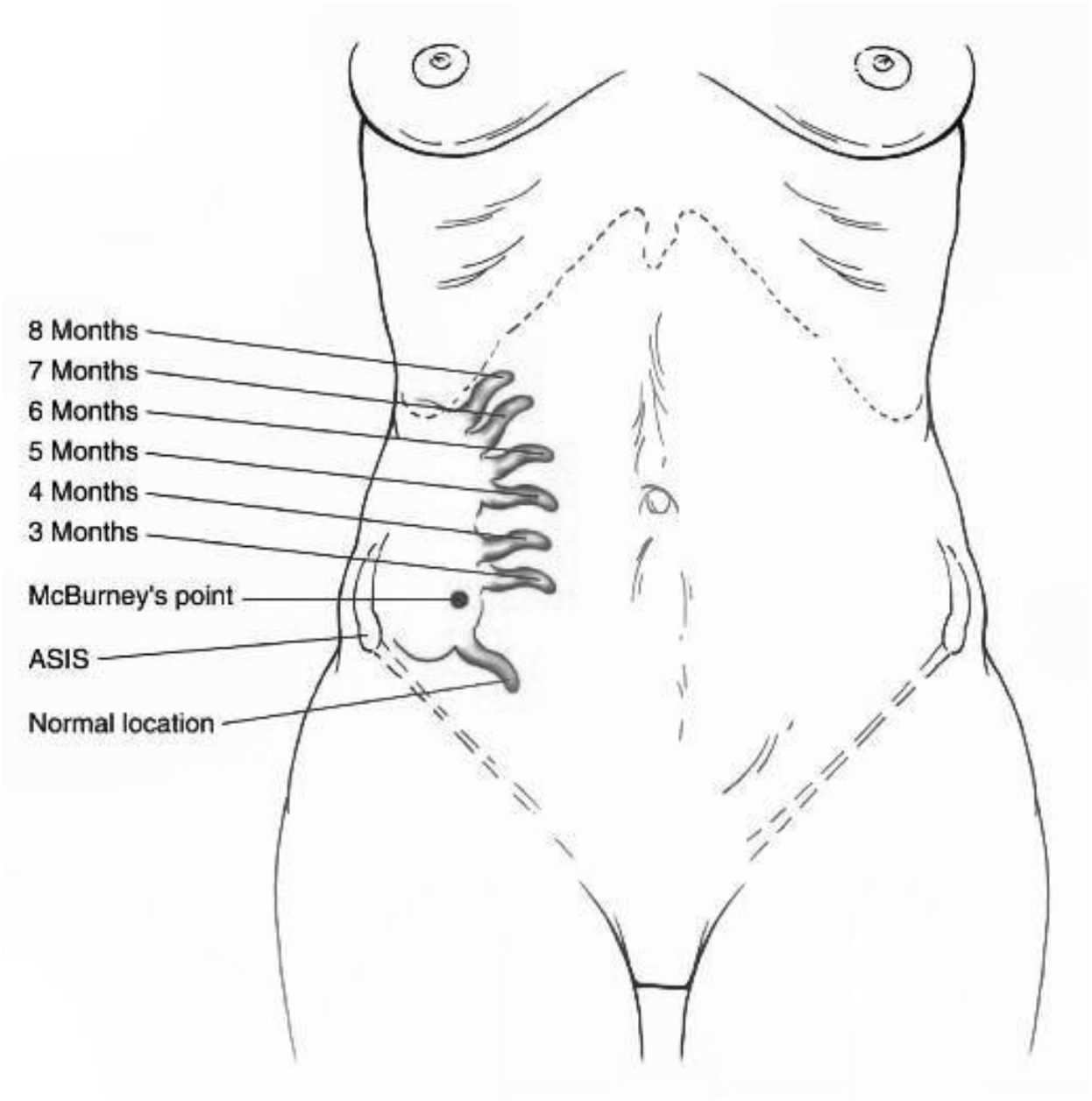


Figure 10: Position of the appendix during pregnancy

In cases, where ultrasound is difficult to diagnose, magnetic resonance imaging (MRI) can be used successfully, so by avoiding ionizing radiation exposure to the developing fetus.

Appendicitis in the elderly patients is very difficult to diagnose because the patients may seek care lately and present with atypical symptoms.

Fever is not common, the white blood cell count is usually normal, and many patients with appendicitis do not have right lower quadrant pain.

About half of the elderly patients are not correctly diagnosed at the time of admission, and these patients have a higher rate of perforation at the time of surgery because of delays in presentation and operative intervention.[74]

More than half of the elderly patients have perforated appendicitis, compared with less than 20% in younger patients.

Diverticulitis and bowel obstruction are most common misdiagnosis in these patient population, and the differential diagnosis have to include malignancies of the gastrointestinal tract and reproductive system, perforated ulcers, and cholecystitis.

CT has become a very valuable tool in the evaluation of abdominal pain among elderly patients, and its use has reduces preoperative hospital delays.[74]

RARE DIFFERENTIAL DIAGNOSIS

Preherpetic pain in the right 10th and 11th thoracic nerves is localized over the same area as that of acute appendicitis.

There is no shift and is associated with hyperaesthesia.

There is no intestinal upset or rigidity. The herpetic eruptions are delayed for 3–8 hours.

Tabetic crises are rare. Abdominal pain is severe and vomiting usher in this crisis. All other signs of tabes confirms the diagnosis.

Spinal conditions may be associated with acute abdominal pain in children and the elderly.

This may include tuberculosis of the spine, metastatic carcinoma, osteoporotic vertebral collapse and multiple myeloma.

Compression of nerve roots leads to pain and may be exacerbated by movement. The lumbar spine rigidity is seen and absent intestinal symptoms.

The abdominal crises of porphyria, diabetes mellitus need to be considered.

Urinalysis should be taken in every abdominal emergency.

In cyclical vomiting of infants and young children, the history of previous attack is present with an absent abdominal rigidity.

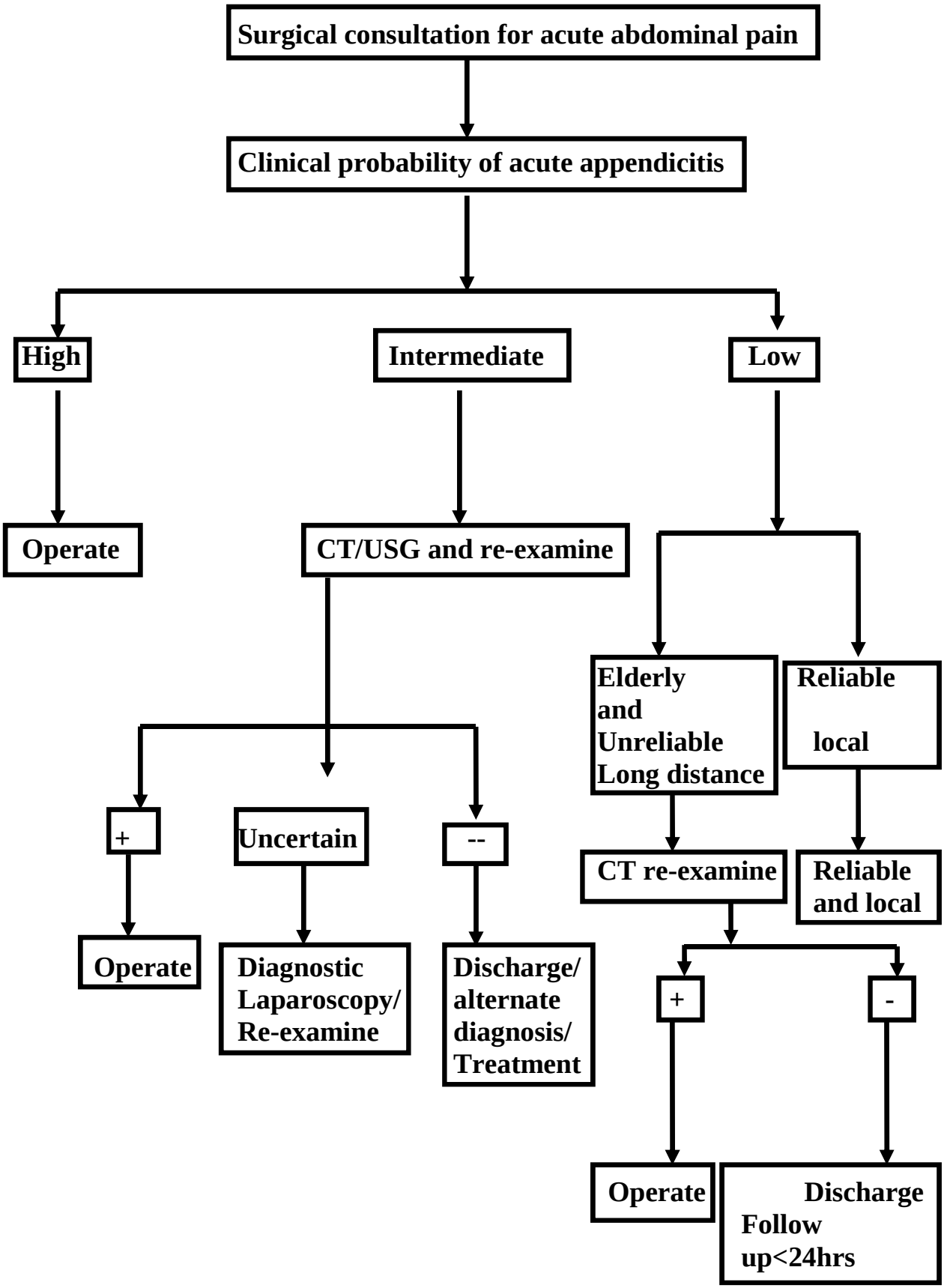
Acetone is found in urine but it is not diagnostic criteria as it may be seen in starvation.

Typhlitis and leukaemic ileocaecal syndrome are rare but fatal enterocolitis occurs in immunosuppressed patients.

Gram-negative and clostridial (Clostridium septicum) septicaemia can be progressive rapidly. Treatment is, appropriate antibiotics and haematopoietic factors.

Surgical intervention is usually not indicated.

DIAGNOSTIC ALGORITHM



INDICATIONS FOR APPENDICECTOMY:

1. Acute appendicitis.
2. Recurrent or chronic appendicitis.
3. Carcinoma of appendix.
4. Carcinoid tumor of appendix.
5. Tuberculosis of appendix.

TREATMENT[50]

The treatment of choice in case of acute appendicitis is appendicectomy.

There is a perception that urgent surgery is necessary to prevent the increase in morbidity and mortality due to peritonitis.

There should not be any delays for those, who are at risk of serious morbidity, are benefited by a period of intensive preoperative preparation.

Intravenous fluids, which is given to establish adequate urine output (catheterisation is necessary only in the very ill patients), and antibiotics should be given.

A single dose of peroperative antibiotics reduces the incidence of postoperative wound infection.

When peritonitis is suspicious, intravenous antibiotics to cover both Gram-negative organisms and anaerobes should be given.

High temperature in children may be treated with salicylates along with parenteral antibiotics and intravenous fluids.

With the use of intravenous fluids and parentral antibiotics, appendicectomy may be deferred after midnight, to first case of the next morning does not increase morbidity.

However, when there is suspicion of acute obstructive appendicitis, operation should not be deferred, than it takes to optimise the patient's condition.

APPENDICECTOMY[50]

Appendicectomy can be performed under general anaesthesia or spinal anaesthesia with the patient supine position on the operating table.

When a laparoscopic technique is used, the bladder should be emptied.

Prior to preparing the abdomen with an antiseptic solution, the right iliac fossa should be palpated for a mass.

If a mass is felt, be preferable to adopt a conservative approach.

Draping of the abdomen is according to the planned operative technique, requirements to extend the incision or conversion of a laparoscopic technique to open technique.

CONVENTIONAL APPENDICECTOMY[50]

Incisions

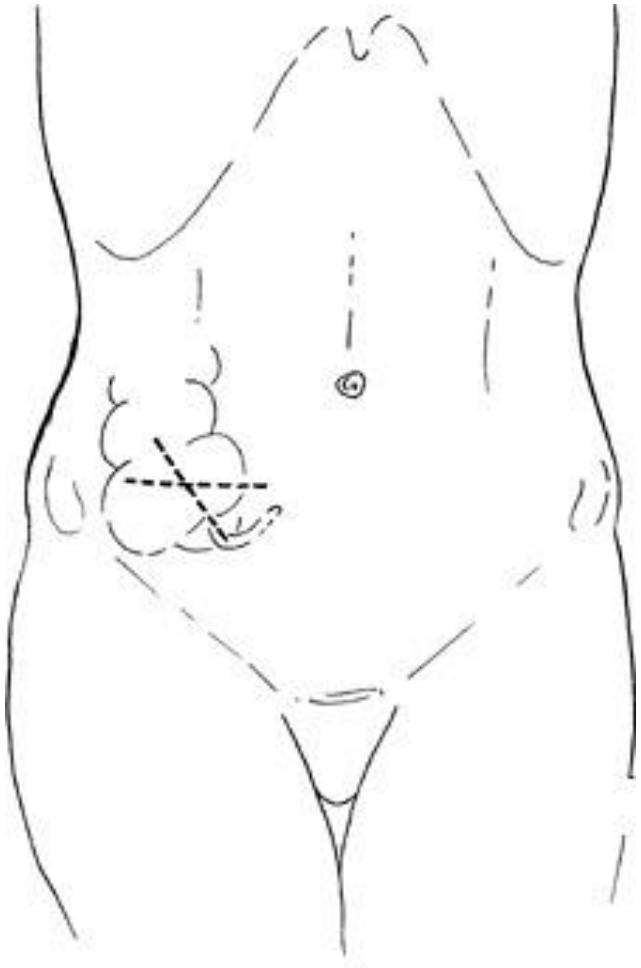


Figure 11: Gridiron incision for Appendicitis & Transverse / skin crease (Lanz) incision for appendicitis

When the preoperative diagnosis is considerably certain, the incision that is widely used for appendicectomy is the so called gridiron incision (grid iron: a frame of crossbeams to support a ship during repairs).

The gridiron incision (which was first described by McArthur) [46] is made at right angles to the line joining the anterior superior iliac spine and the umbilicus, its centre is at the McBurney's point.

In the subcutaneous tissues, a branch from the superficial circumflex iliac artery requires ligation.

The external oblique is incised along the line of its fibres and along the length of the incision.

The fibres of the internal oblique muscle and transversus abdominis muscle are bluntly separated by using clamps spread at right angles to each other, until the transversalis fascia is identified, and with retraction the peritoneum is opened.

If better access is needed, it is necessary to convert the gridiron to a Rutherford Morison incision by cutting the muscles, internal oblique, transversus muscles in the line of the incision.

A transverse skin crease (Lanz) incision has become popular, as the exposure is better and extension is easier.

The incision is made approximately two cms below the umbilicus centred on the midclavicular line.

The external oblique aponeurosis, internal oblique muscle and transversus abdominis muscles are bluntly separated in the direction of the fibres, and the peritoneum opened. When necessary, the incision may be extended medially by retracting or suitably dividing the rectus abdominis muscle.

A lower midline incision may be needed in obese patients, or in patients who have a possibility of having pelvic abnormalities.

When the diagnosis is in doubt, in the presence of intestinal obstruction, a lower midline abdominal incision is to be preferred for a right lower paramedian incision.

The right lower paramedian incision although widely practiced in the past has a difficulty in extending the incision and also more difficult to close, provides poor access to the pelvis and peritoneal cavity.

Rutherford Morison's incision is helpful in case, if the appendix is paraceacal or retrocaecal and fixed.

It is essential for an oblique muscle-cutting incision with its lower end over McBurney's point and extending obliquely upwards and laterally as necessary. All the layers of muscles are divided in the line of the incision.

For simple cases, a small (two to four cms) incision serves to keep the viscera out of the operating field and is sufficient for mobilisation of the appendix and the appendicular base into the wound.

Removal of the appendix[50]

A retractor is placed in the medial side of the wound, peritoneum and abdominal wall is elevated.

Hemostats may be placed on the peritoneum for its identification at the time of wound closure.

Serous exudate is removed by a sucker.

The caecum is identified with the presence of taeniae coli, and using a finger or a swab the caecum is withdrawn into the field.

At the base of the caecum, a turgid appendix may be felt.

Inflammatory adhesions should be broken with a finger, and then the finger is used to hook around the appendix to deliver the appendix into the wound.

The appendix is conveniently handled using a Babcock or Lane's forceps, which is applied in such a way as to encircle the appendix but, not damage it.

The base of the mesoappendix with the vascular arcade is divided between clamps, divided and ligated.

Division of the artery at the appendiceal base is necessary to ensure that, the entire appendix should be removed without leaving an excessive long appendiceal stump.

If the mesoappendix is broad, the procedure can be repeated with a second, or a third haemostat.

The appendix which completely free is crushed, 3mm from its junction with the caecum with a straight clamp, which is removed and reapplied 3mm distal to the crushed portion.

An absorbable 2-0 ligature is tied over the crushed portion of the appendix.

The appendix is divided between the haemostat and the ligature there by avoiding any spillage from the appendix.

The same scalpel can be used to cauterise the exposed mucosa of the appendiceal stump, and the specimen is off the surgical field, minimising contamination.

A non-absorbable suture purse-string or 'Z' suture may be placed into the caecum at about 1.25 cm from the base of the appendix.

The sutures to be taken through the muscle coat, along with the taeniae coli.

The stump of the appendix is invaginated and the purse-string or 'Z' suture is tied, there by burying the appendix stump, for the theoretical purpose to avoid bacterial contamination of the peritoneum and subsequent adhesion formation.[63, 64]

Many surgeons believe purse string invagination of the appendiceal stump is not necessary[65, 66].

The distal ileum visualised to rule out meckel’s diverticulum.

In female patients the ovary examined for any abnormalities.

The peritoneum can be closed with absorbable continuous suture.

The muscles are approximated with intermittent simple absorbable sutures.

The external oblique muscular aponeurosis is closed with continuous absorbable sutures.

The skin closed with non-absorbable subcuticular or mattress suture.

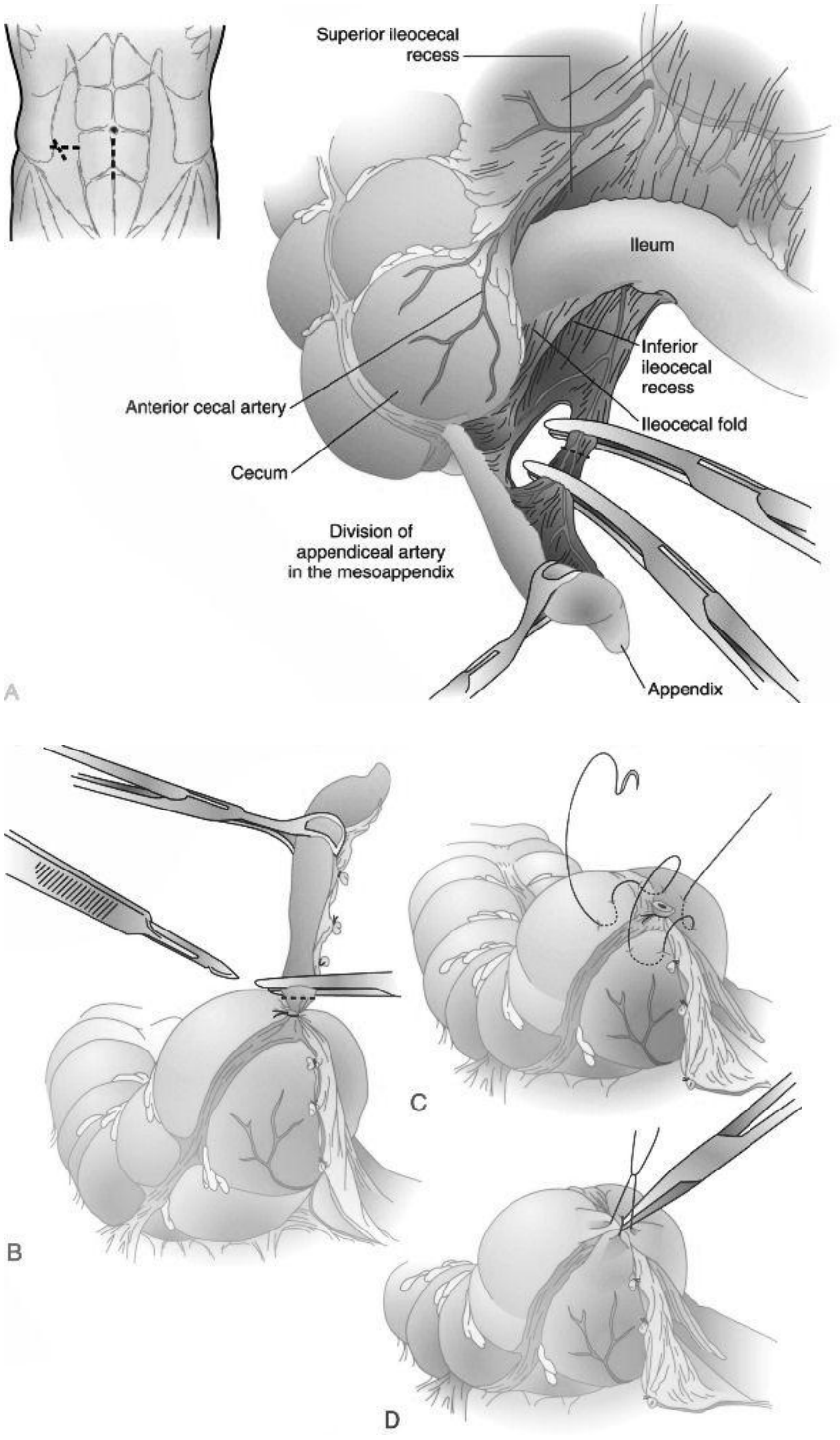


Figure 12: A, Location of possible incisions for an open appendectomy and division of the mesoappendix. B, Ligating the base and dividing the appendix. C, Purse string sutures. D, Inversion of the appendiceal stump.

Methods to be adopted in Special circumstances[50]

The purse-string suture is in danger of cutting out, While the caecal wall is oedematous.

If the oedema is in limited extension, this can be overcome by inserting the purse-string suture into healthier caecal wall at a distance from the base of the appendix.

If the base of the cecum is also affected by inflammation, but there is significant uninflamed cecum between the appendix and the ileocecal valve, an appendectomy along with a partial cecectomy may be performed using a stapling device.[75]

Care should be taken to avoid too narrowing the cecum especially at the ileocecal valve.

If inflammation is extending into the ileocecal junction, an ileocectomy with primary anastomosis may be necessary.

When the appendicular base is inflamed, it should not be crushed but can beligated close to the caecal wall just close enough to occlude the lumen, after which the appendix is amputated and the stump is invaginated.

If the base of the appendix be gangrenous, crushing or ligation should not be attempted.

Two stitches placed through the caecal wall, close enough to the base of the gangrenous appendix, which is amputated and flushed with the caecal wall, after which these sutures are tied.

Second layer closure is done by means of an interrupted seromuscular sutures.

RETROGRADE APPENDICECTOMY: [56]

When the appendix is retrocaecal and also densely adherent, it is an advantage to divide the base between clamps.

The appendiceal vessels are ligated, the stump is ligated and invaginated, and traction on the caecum will enable to deliver the body of the appendix, which is removed from base to tip.

Occasionally, this manoeuvre needs the division of the lateral peritoneal attachments of the caecum.

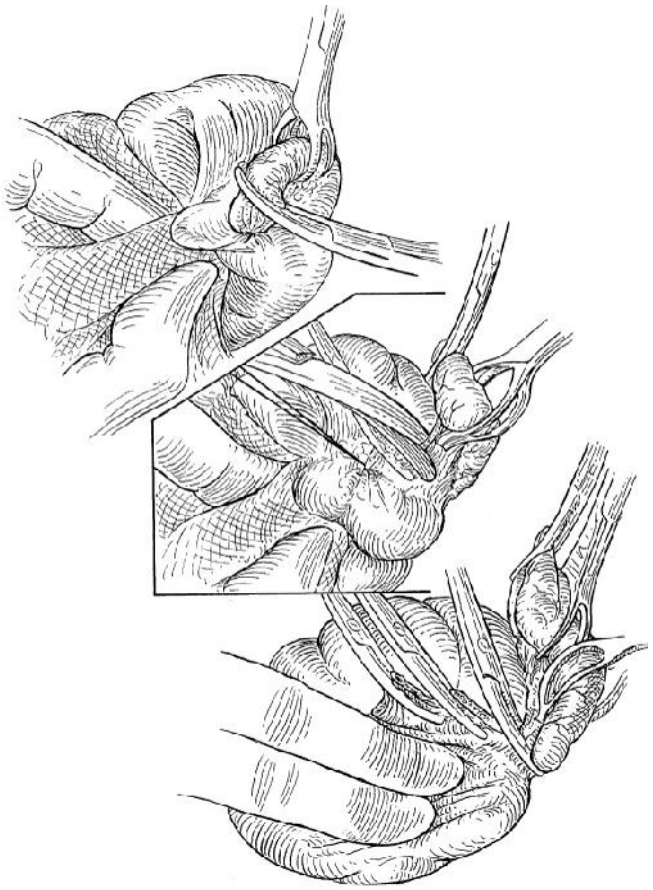


Figure 13: Retrograde dissection of the appendix

LAPAROSCOPIC APPENDICECTOMY:

The word laparoscopy is from a Greek word lapara, meaning “the soft part of the body between ribs and hip, flank, loin” and skopein, means “to look at or survey”.

The laparoscopy in the management of suspected case of appendicitis is, it can be used as a diagnostic tool, particularly in women of child-bearing age.

A three-port technique, one umbilical and one suprapubic port, the third port can be placed in right lower quadrant.

This follows the laparoscopic triangulation principle; the port locations direct the camera and instruments toward the right lower quadrant for clear visualization of the appendix.

The operating ports can be varied according to operator preference and previous abdominal scars.

The operator stands to the patient’s left side and faces the monitor placed at the patient’s foot.

A single dose of a 2ndgeneration cephalosporin is given prophylactically.

Prior to incision, a nasogastric tube and a Foley catheter are used to decompress the stomach and urinary bladder.

All midline incisions have to be oriented vertically, if needed to be converted to an open midline incision is necessary.

A mild Trendelenburg tilt of the operating table helps in delivering the loops of small bowel from the pelvis.

The appendix is found in the usually by identification of the taeniae cli of the caecum and is controlled with a laparoscopic tissue-holding forceps.

By lifting the appendix, the mesoappendix is displayed clearly.

A dissecting forceps, which is used to create a window in the mesoappendix for coagulating the appendicular vessels by using cautery or it can be ligated by using a clip applicator.

The appendix, after coagulating or ligating the mesentry, can be ligated in its base with two absorbable suture endoloops, and divided and removed through the operating ports.

An absorbable suture is used to close the lineaalba at level of umbilicus, and the small skin incisions can be closed with subcuticular sutures.

Patients who undergo laparoscopic appendicectomy are usually having a less postoperative pain and can be discharged from hospital and return to their daily activities sooner than the persons who have undergone open appendicectomy. The incidence of postoperative wound infection is low after the laparoscopic technique; the incidence of postoperative intra-abdominal sepsis can be higher in case of patients operated on for gangrenous or perforated appendicitis.

There is an advantage for laparoscopic over open appendicectomy in obese patients.

POSTOPERATIVE CARE:

Patients with non-perforated appendicitis usually require a 24- to 48-hour hospital stay.

Postoperative cares for both the laparoscopic and open approaches are same. Patients can be given clear liquid diet immediately, and their diet can be advanced as per the tolerance of the patient.

Usually there is no need for postoperative doses of antibiotics.

Patients may be discharged when they can tolerate a regular diet and oral analgesics.

INTERVAL APPENDICECTOMY:

Treatment following nonoperative management of an appendicular abscess is controversial.

Some surgeons recommend interval appendicectomy[76, 77] (appendicectomy performed 6 weeks after inflammation has reduced), while others consider subsequent appendicectomy unnecessary.[78]

Surgeons who advised against interval appendectomy shows a relatively low incidence of future appendicitis (20% or less) [77] and complication rates from interval appendectomy as high as 16%.

It can be now performed laparoscopically on an outpatient basis with low morbidity, [79] interval appendectomies should be considered for the patients who are initially treated with nonoperative management.

POSTOPERATIVE COMPLICATIONS

Postoperative complications occur in about 5% of patients with an unperforated appendix but in more than 30% of patients with a gangrenous appendicitis or perforated appendix.

Postoperative complications after appendicectomy are relatively not common and related to the degree of peritonitis that was present at the time of surgery and associated disorders that may leads to complications

Check-list for post-operative complications for appendicectomy is following:

a) Check the abdomen and wound for an abscess.
b) If pelvic abscess is suspected and a digital rectal examination should be performed.
c) Examine the lungs for any pneumonitis or collapse.
d) Examine the legs for venous thrombosis.
e) Examination of the urine to be done for organisms. (ex.pyelonephritis)
f) Subphrenic abscess should be suspected.

Surgical site infection

Surgical site infection is the most common complication postoperative complication, occurs in 5–10% of all patients.

SSI usually presents as pain and erythema of the wound on the 4^{th} or 5^{th} postoperative day.

Treatment is drainage of wound and antibiotics.

The organisms responsible are mostly a mixture of Gram-negative and anaerobic organisms, most commonly Bacteroides species and anaerobic streptococci.

Intra-abdominal abscess

Intra-abdominal abscess is a relatively rare complication after appendicectomy by using peroperative antibiotics.

Postoperative increasing temperature, malaise and anorexia developing fifth to seventh day after surgery suggest an intraperitoneal collection.

Interloop, paracolic, pelvic and subphrenic sites should be considered. Abdominal USG and CT scanning usually helps in diagnosis and percutaneous drainage can be done.

Laparotomy to be done in patients having intra-abdominal sepsis but most commonly in whom imaging fails to interpret a collection, particularly those with ileus.

Ileus

A period of ileus is to be expected after appendicectomy, and this may be for number of days following removal of a gangrenous appendix.

Ileus for more than 4 or 5 days, along with presence of a fever, is indicative of intra-abdominal sepsis and it prompts further investigation.

Rarely, during postoperative recovery, a Richter's hernia can occur at the site of laparoscopic ports and can be confused with a postoperative ileus.

A CT scan is usually indicated.

Respiratory

In the absence of pulmonary disease, respiratory complications are usually rare after appendicectomy.

Postoperative analgesia and physiotherapy reduce the incidence.

Venous thrombosis and embolism

These conditions are very rarely occurs after appendicectomy, except in the elderly and in women on oral contraceptive pill.

Prophylactic measures reduce the incidence.

Portal pyaemia (pylephlebitis)

This is very rare but a serious complication of gangrenous appendicitis along with high fever, rigors and jaundice.

It is due to septicaemia, which occured in the portal venous system and leads to the formation of intrahepatic abscesses (usually multiple).

Treating with systemic antibiotics and percutaneous drainage of the abscesses is appropriate.

Faecal fistula

Leakage of the appendicular stump is rare, but can be followed if the encircling stitch is too deeply or if the caecal wall with oedema or inflammation. Occasionally, a fistula can follow appendicectomy in Crohn's disease.

Conservative management with low-residue enteral nutrition can result in closure.

Adhesive intestinal obstruction

This is the most commonly occurring late complication of appendicectomy.

On surgery, a single band adhesion is often found to be responsible.

Usually, chronic pain in the right iliac fossa is due to adhesion formation after appendicectomy.

In these cases, laparoscopy is used in confirming the presence of adhesions and it allows division of adhesions.

MATERIALS & METHODS USED IN THE STUDY

This study was a prospective clinical study of randomised selected 100 patients who presented with post-operative complications of appendicectomy in Department of Surgery, Tirunelveli Medical College & Hospital during the study period.

The patients who had presented with post-operative complications of appendicectomy have undergone detailed history taking, clinical examination & investigations like CBC, blood sugar, urea, Xray chest, X ray abdomen, USG abdomen and pelvis after getting the consent of the patient.

Standard proforma was used to collect the details of all the patients involved in the study. Cases included or excluded from the study based on inclusion or exclusion criteria.

INCLUSION CRITERIA:

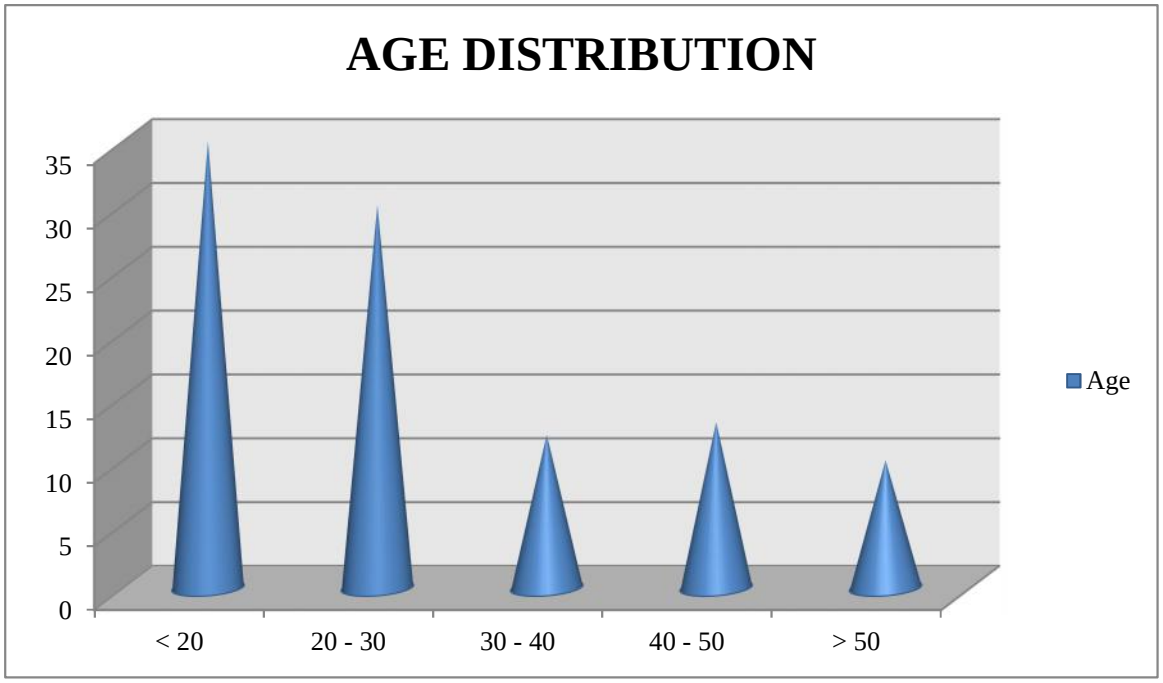
1. Age group more than 12 years.
2. All cases presenting with complications after appendicectomy.

EXCLUSION CRITERIA:

1. Age group less than 12 years.
2. All cases of pregnant women.
3. All cases with Diabetes mellitus.
4. All cases with immune comprised state.

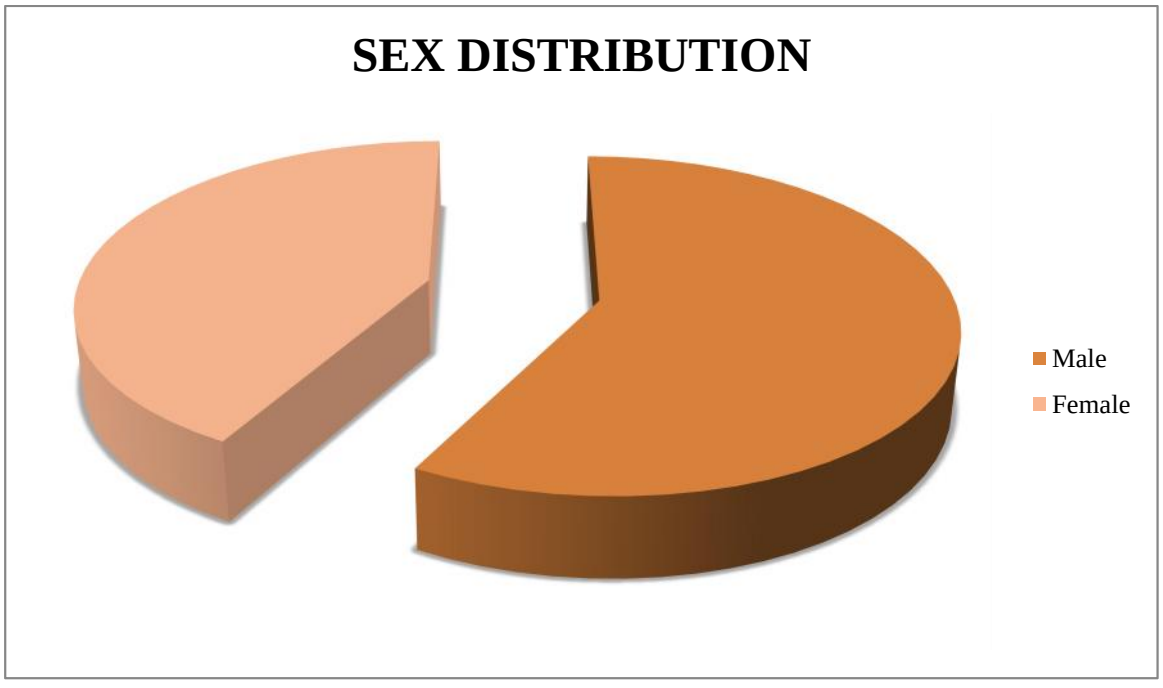
AGE DISTRIBUTION OF POST OPERATIVE COMPLICATIONS OF APPENDICECTOMY

AGE	No. of cases
<20	35
20 – 30	30
30 – 40	12
40 – 50	13
>50	10



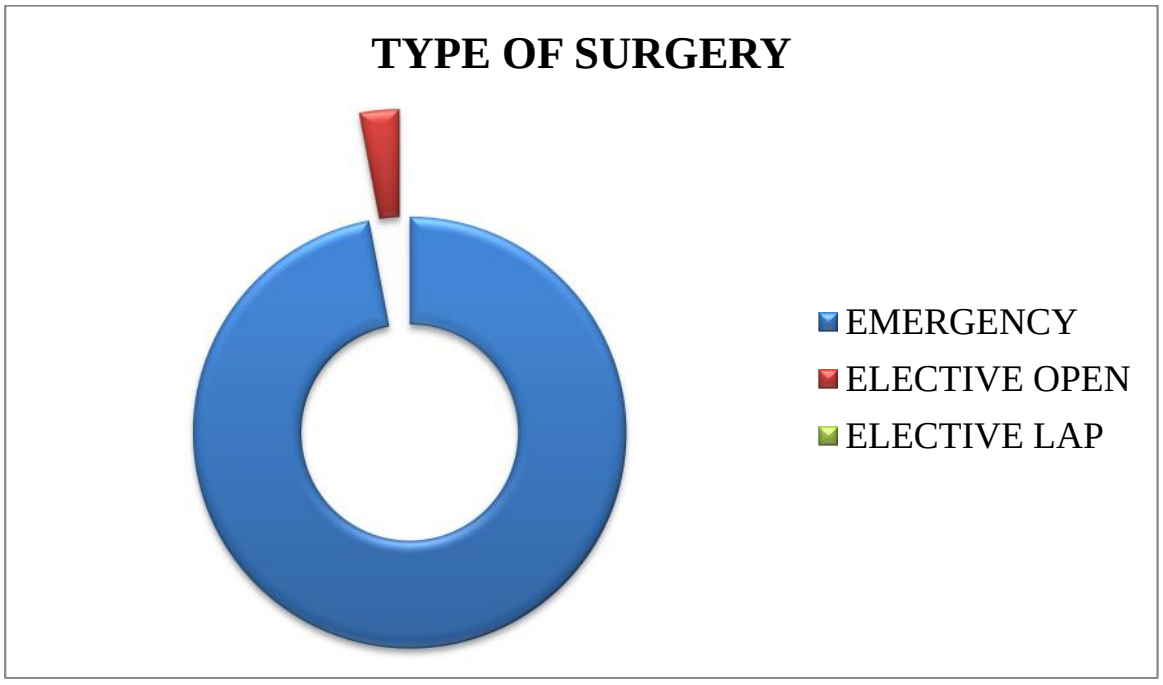
SEX DISTRIBUTION OF POST OPERATIVE COMPLICATIONS OF APPENDICECTOMY

Sex of the patient	No. of cases
Male	58
Female	42



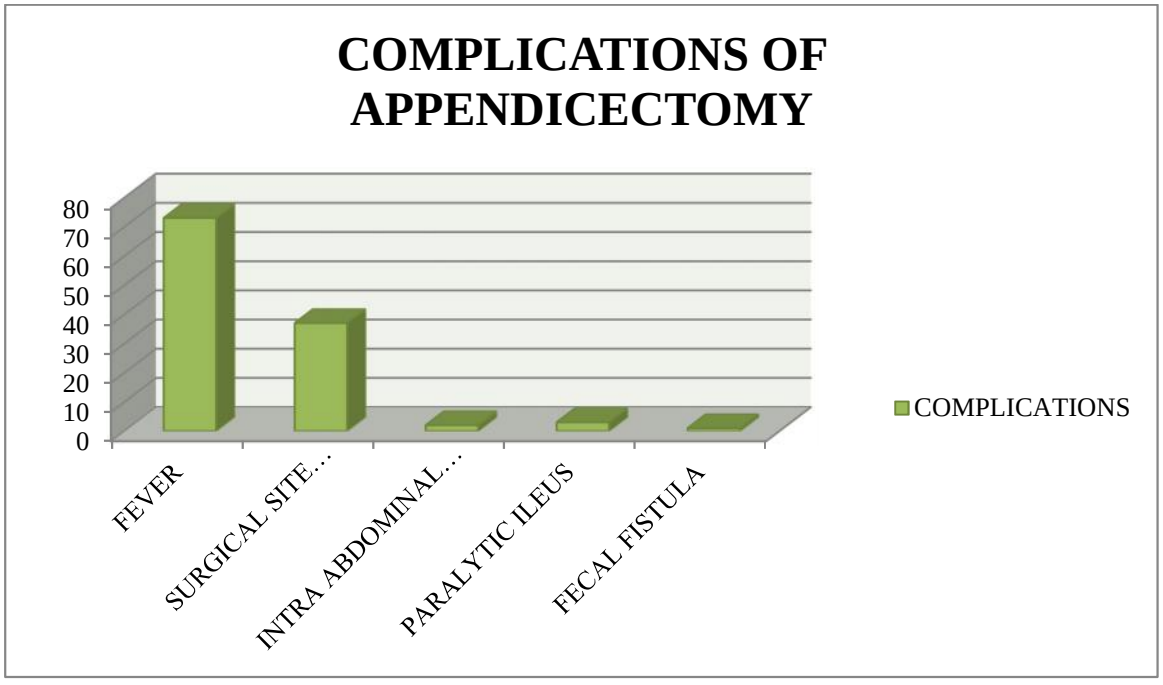
COMPLICATIONS IN TYPES OF SURGERY

Emergency	Elective	
	Open	Laparoscopic
97	3	0



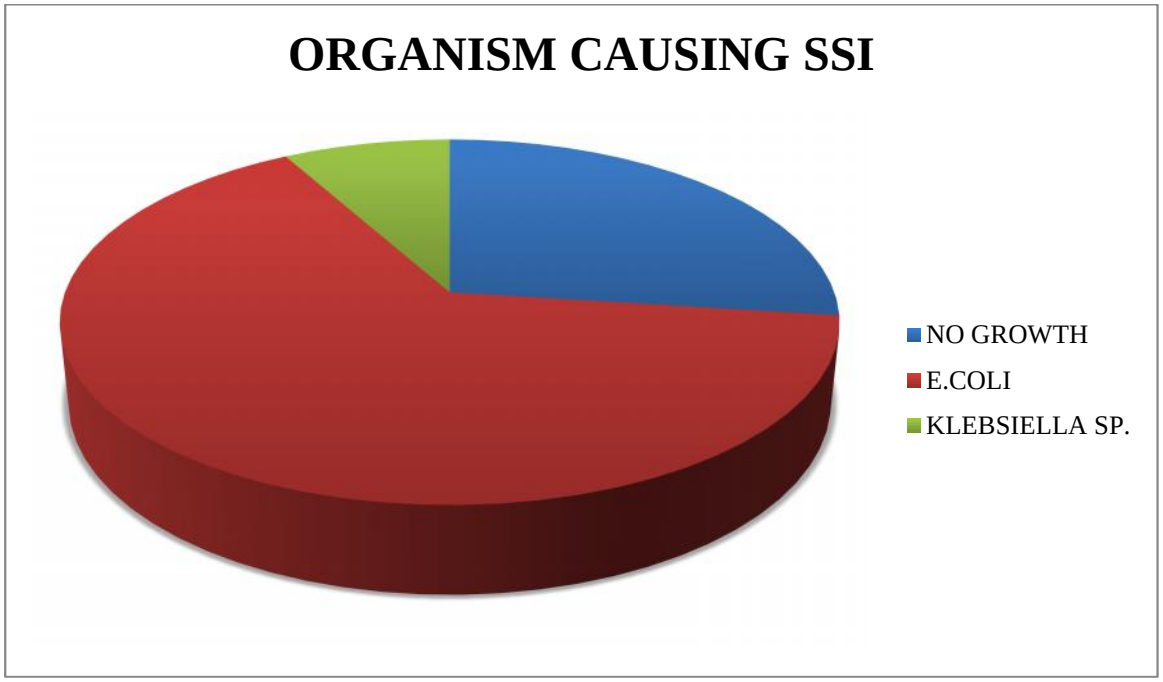
TYPES OF COMPLICATIONS OF APPENDICECTOMY

Complication	No. Of cases
Fever	73
Surgical site infection	37
Intra-abdominal abscess	2
Paralytic ileus	3
Fecal fistula	1



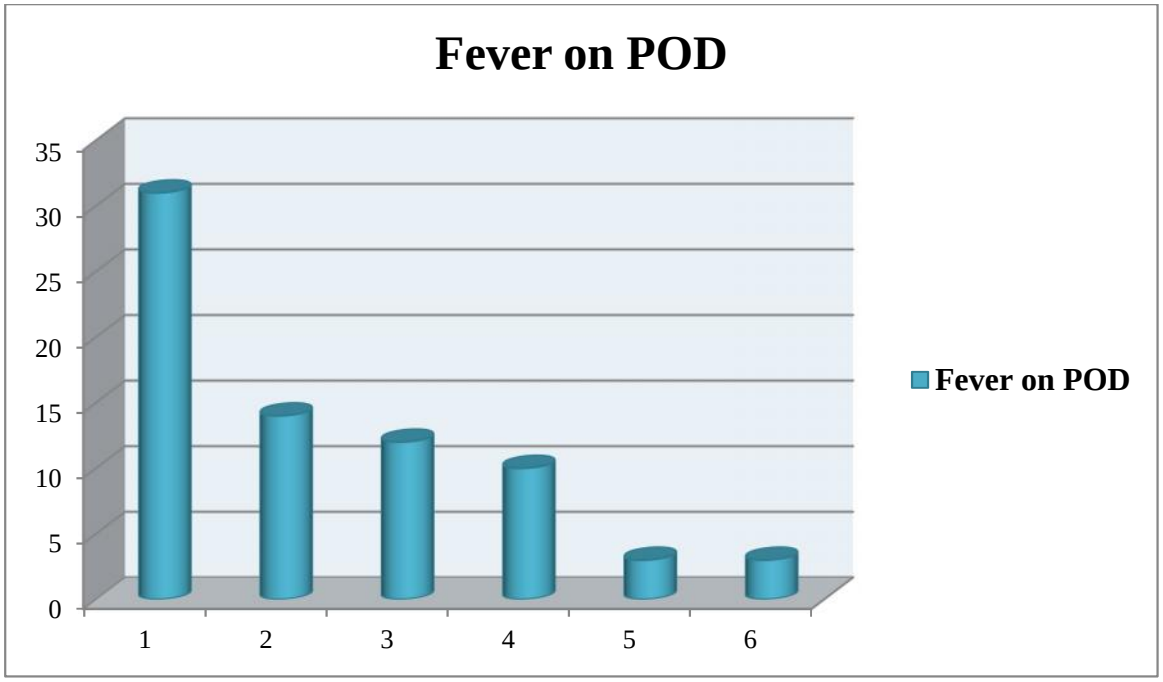
ORGANISMS CAUSING SURGICAL SITE INFECTION

Organisms causing SSI	No. of cases
No growth	10
E.coli	24
Klebsiella sp.	3



POST OPERATIVE DAYS OF FEVER

Post-operative day	No. of cases
1	31
2	14
3	12
4	10
5	3
6	3



DISCUSSION OF THE STUDY OF POST OPERATIVE COMPLICATIONS OF APPENDICECTOMY

In the current study out of the 100 cases 73% of the cases were having fever & 37% of the cases were having surgical site infections.

The diagnosis of complications of the patient was based on clinical examination & investigations.

In cases of surgical site infections, there are 37 cases reported with SSIs.

Among the 37 cases, 10 cases have no growth on culture, 24 cases have growth with E.coli and 3 cases have growth of Klebsilla sp.

All the 10 cases having no growth in culture are associated with either no fever or with fever in first and second POD.

Among 24 cases having the growth with E.coli, All cases are presented with fever on 4 – 6 PODs.

E. coli is the commonest facultative anaerobe in the colon and feces.

In study E. coli was found to be the commonest cause of surgical site infection like study conducted by Schnuriger et al. found to be the most common isolated species in the presence of colonic injury was E. coli (64.7%) (Schnuriger et al. 2010)

All the 3 cases presented with, culture showing Klebsiella sp. have fever on 5 – 7 PODs.

Anvikar et al documented that Klebsiella pneumoniae was one of the commonest bacteria causing SSI in general surgical wounds.

Other investigations for fever such as widal, dengue antigen, blood culture, urine culture are negative for these patients with fever.

All the cases of surgical site showing the organismal growth are treated with the appropriate sensitive antibiotics.

Our study shows there is contamination of surgical wounds from the organisms of the bowel during appendicectomy surgery.

It also shows the commonest organism causing infection is E.coli, which is a commonest anaerobic organism of bowel.

Most common complication of our study is the post-operative fever.

Fever among the post-operative patients occurs more commonly on 2^{nd} and 3^{rd} POD, which shows the inflammatory reaction due to appendicitis itself.

The fever which occurred on 5^{th} or 6^{th} POD is most commonly due to SSIs.

There are 3 cases presented with paralytic ileus.

The intraperitoneal infection which spreads among the coils of intestine is the first step in the development of paralytic ileus.

The pre-operative diagnoses of the cases presented with paralytic ileus are perforative appendicitis with guarding and rigidity of the abdomen.

Most probable cause of paralytic ileus is the peritonitis caused by the appendicular perforation and inflammation.

There is no electrolyte imbalance noted in these patients.

There are 2 cases reported to have intra-abdominal abscess.

One case has a pre-operative finding of appendicular perforation with generalized peritonitis. For that, after appendicectomy, a peritoneal lavage was given, in 8th POD; the patient has tachycardia, elevated temperature. Thus, USG abdomen was taken; there is an 8x4 cm collection of free fluid, which was drained later through rectal drainage.

Another case of intra-abdominal abscess, presented also as a case of perforated appendicitis, after appendicectomy, on 5th POD, patient presented with continuous fever, abdominal pain. USG abdomen was done, which shows a 4x3 cm free fluid in the abdominal cavity in right iliac fossa, which was treated conservatively with antibiotics, on repeated USG abdomen, the free fluid reduced.

A case of fecal fistula, which was presented pre operatively as a case of acute abdomen showing signs of peritonitis, per operatively, there is perforation of appendix with destroyed appendix. Extensive ceacal inflammation was seen. Appendicectomy was done, abdomen closed with an open drain. In 5th POD patient have fecal fistula through the drain; patient was passing stools via naturalis also. Patient was treated conservatively with antibiotics, intra venous fluids to correct the electrolyte imbalance. The fecal fistula reduced from 10th POD. The drain was removed after the drain becomes dry of fecal fistula.

CONCLUSION OF THE STUDY OF POST OPERATIVE COMPLICATIONS OF APPENDICECTOMY

Acute appendicitis is one of the most common presenting problems in the surgery and emergency outpatient department of Tirunelveli Medical College & Hospital. For which appendicectomies were done as emergency and elective basis. For elective cases both open and laparoscopic appendicectomies are done.

The following conclusions were obtained from the above prospective clinical study conducted at Tirunelveli Medical College & Hospital during the period of October 2012 to September 2013.

- Of the 100 cases, the commonest complication seen in post-operative appendicectomy is fever.
- There are 73% of cases presented with fever.
- About 61% of patient presented with fever, have risen in temperature on 2^{nd} and 3^{rd} POD.
- It implies that the fever is due to inflammation caused by the appendicitis itself.
- Among the cases with fever, about 37% of cases also have surgical site infections.

- The cases having the rise in temperature due to surgical site infections are on 4^{th} and 5^{th} PODs.
- Other cases of fever are ruled out.
- There are 37% of cases presented with SSI.
- In cases presented with SSI, there was about 27% of cases shows no growth of any organisms in the culture.
- Those patient who have no growth of organism in culture, were presented with rise in temperature on 2^{nd} of 3^{rd} POD, it signifies the fever is due to the inflammation caused by the appendicitis but not by the SSI.
- In cases presented with SSI, there was about 64.86% of cases have E.coli grown on culture.
- E.coli is the most common organism causing SSI in the cases undergoing bowel surgeries is due to contamination of subcutaneous tissue with the bowel contents.
- In cases presented with SSI, there was about 8.01% of cases have Klebsiella sp. grown on culture.
- There are 3% of cases reported to have paralytic ileus.
- All the 3 cases are pre operatively, diagnosed as perforated appendicitis.
- They have peritonitis due to inflammation of the appendix spread throughout the peritoneal cavity.

- The probable cause of paralytic ileus is the spread of intraperitoneal infection among the coils of intestine.
- There are 2% of cases presented with intra-abdominal abscess.
- One of the intra-abdominal abscesses which were in the pelvic cavity was drained rectally.
- Other was treated conservatively.
- 1% of cases were presented with fecal fistula.
- It was treated conservatively.

Fig 1: Surgical site infection

Fig 2: Surgical site infection

Fig 3: Surgical site infection

Fig 4: Fecal fistula

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ANNEXURE I

PROFORMA

Name: S.NO:

Age: Sex: Occupation:

OP/IP no:

COMPLAINTS:

Fever Onset – Gradual Duration

Wound – site duration associated pain

Type of discharge – Serous / Purulent / Feaculent

Abdominal pain Onset Duration

Aggravating factor Relieving factor

H/O passed flatus

H/O passed motion

PAST HISTORY:

Operation: Emergency/ Elective – Open / Laparoscopic

PERSONAL HISTORY:

Smoking Alcohol intake

DM HT

FAMILY HISTORY:

DM SHT

GENERAL EXAMINATION:

Anemia Jaundice Cyanosis Oedema

VITAL SIGNS:

PR: RR: BP: Temp:

LOCAL EXAMINATION:

INSPECTION:

Shape of the abdomen

Surgical wound

Wound discharge

PALPATION:

Skin temperature Tenderness Organomegaly

AUSCULTATION:

EXAMINATION OF OTHER SYSTEMS:

CVS: RS: CNS:

PROVISIONAL DIAGNOSIS:

INVESTIGATIONS:

CBC: TC DC Hb ESR PCV

MCV MCHC MCH Pl. count

SUGAR UREA CREATININE ELEC

URINE ROUTINE

CXR XRAY ABDOMEN

ECG

USG ABDOMEN AND PELVIS

TREATMENT:

ANNEXURE II: MASTER CHART

S.NO	PATIENT NAME	IP NO	AGE	SEX	ELECTIVE O/L	EMERGENCY	FEVER	SSI	INTRA-ABDOMINAL ABSCESS	FECAL FISTULA	PARALYTIC ILEUS
1.	ADAM FATHIMA	61545	25	F		+	+				
2.	AHAMED	35691	16	M		+	+				
3.	ANANDASELVI	25636	24	F		+	+				
4.	ANITHA	62873	35	F	+ / O		+				
5.	ANTONY MOSES	16376	14	M		+	+				
6.	ARJUNAN	20169	50	M		+	+				
7.	BAKIYALAKSHMI	13105	29	F		+	+				
8.	BALASUBRAMANIAN	22646	20	M		+	+				
9.	CHANDRASEKAR	35010	45	M		+	+				
10.	DEVASUNDARI	1908	16	F		+	+				
11.	DINESH	43402	13	M		+	+				
12.	DURAI	43637	23	M		+	+				
13.	ESAAKIAMMAL	53492	13	F		+	+				
14.	ESSAKI	17139	14	M		+	+				
15.	ESSAKIAMMAL	34593	30	F		+	+				
16.	ESSAKIRAJA	55180	25	M		+	+				
17.	FATHIMA BENOZIR	64734	16	F		+	+				
18.	GANDHISELVI	30087	27	F		+	+				
19.	GANTHIRAJA	2986	39	M		+	+				
20.	GURUNATHAN	19455	18	M		+	+				
21.	GURUNATHAN	31293	19	M		+	+				
22.	IMMANUEL	9805	34	M		+	+				
23.	INDIRA	47037	32	F		+		+			
24.	IYYAPPAN	25937	20	M		+		+			

25.	KAJENDRAN	27575	20	M		+	+				
26.	KALIAMMAL	33367	29	F		+	+				
27.	KARUPPASAMY	30832	27	M		+	+				
28.	KATHIRVEL RAJ	40179	33	M		+	+	+			
29.	KUSHBOO	13350	17	F		+	+				
30.	LAWRENCE	14599	24	M		+			+		
31.	MADHAVI	37700	18	F		+	+	+			
32.	MAHARAJA	658	13	M		+		+			
33.	MAHARASI	60141	28	F	+ / O		+				
34.	MALA	24655	23	F		+	+				
35.	MALA	395	16	F		+	+	+			
36.	MALAISAMY	53991	60	M		+	+				
37.	MALAIYARASAN	34726	27	M		+	+	+			
38.	MANI	65621	50	M		+		+			
39.	MANICKAM	20426	14	M		+	+				
40.	MANONMANI	16056	72	F		+		+			
41.	MARIDURAI	23457	26	M		+	+				
42.	MARISELVAN	16913	20	M		+	+				
43.	MARIYAMMAL	30388	30	F		+	+				
44.	MASANAM	16311	70	M		+	+	+			
45.	MEENA	70303	44	F	+ / O		+				
46.	MOORTHY	64783	23	M		+	+				
47.	MUNIYAMMAL	40689	55	F		+	+	+			
48.	MURUGAN	54591	25	M		+	+				
49.	MURUGAN	54425	45	M		+	+	+			
50.	MURUGARAJ	29838	42	M		+	+				
51.	MUTHU MARI	55690	38	M		+					+
52.	MYTHEEN ABDUL KATHAR	54218	21	M		+	+				
53.	NARAYANA VADIVU	5390	55	F		+	+				
54.	PALANI	43877	33	M		+		+			
55.	PANDI	51731	65	M		+	+				
56.	PAPPA	62330	44	F		+		+			
57.	PARAMASIVAM	12929	25	M		+		+			

58.	PARTHIBAN	32075	22	M		+	+				
59.	PARVATHY	58039	64	F		+		+			
60.	PATTATHIAMMAL	15444	30	F		+		+			
61.	PAUL DURAI	46933	42	M		+		+			
62.	PERUMAL	55873	26	M		+		+			
63.	PETCHIAMMAL	52500	18	F		+	+				
64.	PITCHAMMAL	52173	65	F		+	+				
65.	PONNAPPA NARAYANAN	32559	22	M		+				+	
66.	POOMARI	30057	19	F		+	+				
67.	PUSHPALATHA	17310	18	F		+	+				
68.	RAJA	66710	20	M		+	+				
69.	RAM RAGAVENDRA	5479	17	M		+	+				
70.	RAMALASHMI	35158	33	F		+	+				
71.	RASOOL AYESHA	67356	27	F		+		+			
72.	ROSEMARY	39784	18	F		+	+				
73.	SANKARAMMAL	12825	43	F		+	+	+			
74.	SANKARAMMAL	23551	48	M		+	+	+			
75.	SARAVANAN	23607	29	M		+					+
76.	SATHISH	42480	17	M		+					
77.	SEIKH MYDEEN	54868	53	M		+		+			
78.	SELVAM	51401	50	F		+	+				
79.	SELVI	27259	39	F		+		+			
80.	SENTHIL SELVI	64728	30	F		+		+			
81.	SERMARAJ	41293	50	M		+	+				
82.	SHANTHI	13889	40	F		+	+				

83.	SHANTHI	42344	56	F		+		+			
84.	SISILIYA	37391	40	F		+	+				
85.	SIVASUBBU	42408	46	M		+	+	+			
86.	SOUNDARA RAJAN	46828	24	M		+		+			
87.	SUBBAIAH	38132	20	M		+		+			
88.	SUBRAMANIAM	52212	30	M		+	+	+			
89.	SUBRAMANIYAN	41483	20	M		+	+	+			
90.	SUDALI	14834	38	M		+	+	+			+
91.	SURENDRAN	55627	17	M		+	+	+			
92.	TAMILARASI	36533	17	F		+		+			
93.	THANGAPANDI	27121	20	M		+	+	+			
94.	THANGAPERUMAL	50259	21	M		+	+				
95.	THOMAS	33344	19	M		+	+				
96.	VADIVUKARASI	4479	19	F		+	+				
97.	VEERAPANDI	61258	27	M		+		+			
98.	VEERASUDHA	63829	20	F		+		+			
99.	VELLATHAI	29633	14	F		+	+				
100.	VENKATESH	20580	17	M		+	+	+	+		